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LIVE ARTICLES
ON
SPECIAL HAZARDS

No. 1

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Weekly
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LIVE ARTICLES
ON
SPECIAL HAZARDS

A Series of Articles Reprinted from
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FOREWORD.

"Jack at all trades and master of none" is a term of reproach in these days of specialized effort. But of the successful fire insurance specialist it may be said that he must be "Jack at all trades to be master of *one*." Modern fire underwriting conditions are such that the successful fire insurance man must have at least a working knowledge of the various manufacturing processes carried on in the risks which he insures, and of course the more he extends his information along these lines the more benefits he will reap therefrom. Experience is undoubtedly the best teacher, but its price is high and its course a long one to pursue. It furnishes no text books, and its examinations are usually severe.

In preparing the series of articles presented herewith it has been the aim of the publishers to produce something in the nature of a reference text book to supplement actual experience. The cub inspector going into a cotton mill for the first time is confronted by a series of bewildering manufacturing operations. How much easier would the work be for him if he knew just where the process begins, and which processes require special attention from the fire insurance viewpoint! The veteran inspector who has not visited a paint factory for years may wish to refresh his memory as to the chemistry of oxidation of leads and oils just prior to looking over a new risk in his field. It is hoped that the "Live Articles" presented herewith, and those which are being published currently in THE WEEKLY UNDERWRITER, may in a good measure answer this need.

The appreciation of the public interested in insurance for these articles has already been manifested to the publishers, who take this opportunity of thanking the contributors for the altruistic spirit which has prompted them to give others the benefits of their own experience.

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COTTON MILLS.

Manufacturing Processes and Hazards, as Related to Fire Insurance—A Study of the Causes of Fires and Methods of Fire Prevention and Protection in Cotton Mills.

By Anson G. Wilbor, Inspector, with the Factory Insurance Association, Hartford, Conn.

By reason of the combustibility of the material used, the cotton textile industry is necessarily associated with fire insurance in many ways. The first point of contact comes shortly after the cotton is harvested, when, in the form of seed cotton, it is placed in the gin or the farmer's barn, and insurance is sought by the owner to protect him from loss by fire. From this time on the two interests are in close and constant touch, as the cotton passes through the various stages of its progress toward the finished manufactured product, until it finally reaches the counters of numberless stores throughout the world, in the form of dress goods, lace curtains, clothing, blankets and many other forms, but the contact does not cease there. It still endures in the form of insurance on the contents of thousands of homes, and then, as rags for paper stock, continues to command the underwriter's attention, and, finally, in the form of paper made from these rags, the cycle terminates.

It is not within the scope of this article, however, to follow up all the various ramifications of business in which cotton textiles and fire insurance are mutually associated, and we will confine ourselves to the relationship existing in the manufacturing branch only.

We will first consider briefly the principal hazards in cotton textile mills, together with the most approved methods of safeguarding them, outlining the several manufacturing processes through which the cotton passes from the time of entering the mill until it leaves same, and in connection with each process point out the hazards and safeguards therefor.

COTTON WAREHOUSES.

Cotton reaches the mill in the form of a bale weighing usually about 500 pounds. It is covered with burlap and bound with iron bands called ties. If the mill is located near the point where the cotton is raised, this bale will be in the form known as the "gin" or "soft" bale. If, however, the mill is at any considerable distance from the point of origin of the cotton, the bale will be received at the mill in the form known as a "compressed" bale, which is a soft bale after it has been placed in a powerful press, which reduces its volume over 50 per cent., the object of this compression being to economize room and thereby save freight cost in shipping long distances, as charges are based on minimum weights per car.

When the cotton is received at the mill it is placed in a storehouse until needed. Two methods are customary in storing cotton. One way, which was formerly the universal custom, is to build a one story warehouse, making it from 12 feet to 20 feet high, and tiering or piling the cotton bales on their sides as high as the height of the warehouse will permit. This is a very bad practice, as in event of fire the top tiers act as a roof to keep water from reaching the fire, which can thus unhindered spread throughout the pile. Hence, fires in warehouses, where cotton is tiered, always result in large losses unless they happen to start on the top of the pile.

The other method, which is now advocated by all insurance interests and is admitted by the mill interests to be the best, is to build warehouses of only about 7 feet in height, and then place the cotton in them one bale high on end. This type of warehouse may be made more than one story high, each floor being made water-tight and pitched slightly toward one side, where scupper holes are provided through the wall to carry off water. This method permits free access of water to the fire, and thus prevents its spread throughout the warehouse.

CAUSES OF WAREHOUSE FIRES.

The three principal causes of cotton warehouse fires are, first, matches dropped from pockets of employees and afterward stepped on or run over by truck wheels. Second, matches that have gotten into the bale during the baling processes or during transportation are ignited by rats accidentally biting them while getting nest material; and third, from the breaking out of a spark that may have dropped into the baling press when the cotton was being baled and smouldered in the bale, gradually eating its way toward the surface. It is a very well authenticated fact that a spark buried in the centre of a tightly packed bale will smoulder for days before breaking out. This is a real hazard to mills near the place where the cotton is raised and ginned, and decreases rapidly as the distance of the mill from the source of supply increases, because this lengthens the time that must elapse before the bale reaches the mill, and gives opportunity for a fire to show up before the mill warehouse is reached.

PREVENTIVE MEASURES IN WAREHOUSE.

The preventive steps to be taken in connection with warehouse hazards are education of employees to use safety matches, or, better yet, to use none, and careful inspection of every bale that goes into the warehouse. The steps to be taken to minimize the loss in event fire does come are, first, store all cotton one bale high on end; second, limit area of warehouse sections; third, provide fire extinguishing equipment.

THE OPENING ROOM AND ITS HAZARDS.

From the storehouse the cotton goes to the opening room, which, as its name indicates, is the place where the ties and bagging are removed and the bales pulled apart or opened; usually the cotton from a number of bales is mixed in a large pile known as the "batch."

There are two general methods employed in handling cotton in the opening room. One makes use only of manual labor and the other combines hand with machine work. They are known respectively as hand opening and machine opening.

The hand opening room hazards are moderate and may easily be eliminated by the employment of careful and reliable employees in this department. Practically every fire which occurs in a hand opening room is caused by matches dropped from the pockets of employees and afterward stepped on. If the employees who have access to the opening room could be prevented from carrying matches, or induced to use only safety matches, fires in hand opening rooms would be almost unknown. There are a very few instances in which fires in hand opening rooms have been caused by the use of an axe to cut the ties from the bale. Occasionally sparks would be struck from the contact of the axe with the tie, which were of sufficient magnitude to ignite the cotton. The remedy for this is to use one of the regular tie cutting tools of which several reliable makes are on the market.

In machine opening the ties and bagging are removed by hand. Large slabs of cotton are then pulled from the bales and run through a machine known as a bale breaker, which breaks the large masses of cotton up into small lumps, which are usually carried by a slatted apron conveyor to a battery of machines known as automatic feeders and preparers, whose function is to break up the lumps and get the cotton into a smoother and more uniform condition. In machine opening rooms we, therefore, have the same hazards as in hand opening, with the addition of the possibility of foreign substances in the cotton striking fire when passing through the machines. This hazard is not so great as in the picker room, because the opening machinery runs at much slower speed than the picking machinery.

THE PICKER ROOM.

The opening room is usually connected with the main mill picker room by a galvanized iron pipe, and by means of a fan the cotton is either sucked or blown from the opening room to the picker room. The picker room is frequently also spoken of as the breaker room and lapper room, the machines in this room being known as the breaker, intermediate and finisher lappers. These machines consist of a cylindrical metal box inside of which a steel shaft, to which are attached arms, revolves at a speed of about 1,500 revolutions per minute. The cotton in passing through this box is beaten to a loose, fluffy condition by the rapidly revolving arms, and dust, stones and other foreign substances are knocked out and pass through the slits of a grid, which forms a portion of the metal enclosure. The cotton is delivered through a slit in one side of the box, in the form of a sheet, and is rolled around a steel rod into a cylindrical roll known as a lap.

The picker room is the most hazardous part of the cotton mill, and as the cotton progresses through the different departments the manufacturing hazards grow less and less. The reason for this is that the chief hazard in working cotton arises from the presence of foreign substances in the cotton, such as matches, nails, stones, etc., which, when passing through the machines, are almost certain to cause sparks when struck by the rapidly moving metal parts of the machinery. As the cotton progresses through the various stages of manufacturing the foreign substances become less, until by the time the third stage is reached there is practically no further danger from this cause. Since the chief danger in the picking department arises from foreign substances in the cotton, this hazard may be decreased by carefulness on the part of the employees in this department to keep a close watch upon the stock that goes into the machines to see that no foreign material is placed in them with the cotton. The match hazard here is also a prolific source of fires. This may be reduced in the same manner as suggested in connection with the opening room hazards. On account of the high speed of the revolving parts of the breakers there is an opportunity for hot bearings, in case attention is not given to proper oiling.

In those mills which use the outside opener system the picker room hazard is materially reduced by reason of the fact that all of the larger pieces of foreign matter will fall out of the cotton when picked up by the suction from the fan used to transport same to the picker room, and to facilitate this the intake pipe should rise vertically a distance of 10 feet to 12 feet before taking the direction necessary to reach the picker room.

THE CARDING AND DRAWING PROCESSES.

The next process after the cotton leaves the picker room is known as carding. This process consists in passing the cotton between rapidly revolving cylinders, thickly covered with wire bristles or teeth, the object being to straighten out the cotton fibres and lay them parallel to one another. Here the chief hazards are from foreign substances passing through the machine striking sparks, or some of the card clothing on one of the cylinders may become loosened up and strike against the companion cylinder, thereby causing sparks.

The next process is known as drawing, and, as already noted, when this stage of manufacture is reached the hazard due to foreign subtances in the cotton is eliminated. From now on through the various preparatory processes, consisting of slubbing, speeding, spinning and weaving, the only hazards are hot bearings, due to neglect of employees to properly care for same, or the striking of sparks by reason of improper adjustment or breakage of some part of the machines. This latter cause is so remote as to be almost negligible.

FIRE HAZARDS AND THEIR REMEDIES.

Many people have an idea that cotton itself possesses some inherent properties which will cause it to ignite spontaneously. This is an error. There is no inherent hazard in cotton, and there is nothing in ordinary cotton mill processes that is likely to bring about spontaneous combustion.

While cotton mill hazards may, to a considerable extent, be removed, it is impossible to entirely eliminate them; hence after removing the causes, so far as possible, we must provide remedies to cure those causes which will inevitably arise. The one all sufficient remedy is water, and the best medium for its application is the automatic sprinkler. A valuable adjunct in reducing the loss likely to arise from any one fire is segregation of processes.

The influence exercised by the insurance interests upon the cotton manufacturing interests is very great, and has more especially affected, first, the construction of the buildings in which the manufacturing processes are carried on; second, the arrangement of the processes; third, the processes themselves, but in a much smaller degree, and fourth, the machinery used, this latter item being the one least influenced.

The effect of these influences has been to greatly lessen the hazards incident to cotton manufacturing, so that while it was formerly considered one of the more hazardous manufacturing enterprises, it is now considered to be one of the safest. Let us consider separately each of the four points just mentioned as having been especially influenced by insurance interests.

CONSTRUCTION OF BUILDINGS.

Cotton manufacturing was originally carried on in buildings of cheap and inferior construction, in fact little if any attention was given to the construction of the buildings, excepting that they be large enough to contain the machinery and strong enough to sustain the loads which it was necessary for them to carry. Hollow walls, blind attics and concealed spaces were the rule rather than the exception, and all-frame construction was very common.

Buildings of this type, especially when containing quantities of such inflammable material as cotton, are almost certain to be a total loss in event of a fire starting in them. As a consequence, the insurance cost was high, and became such an important item in the cost of production that manufacturers began to seek for some means whereby this cost might be reduced.

The first move toward the attainment of this end was to put up buildings in which fires would not spread so rapidly and where there would be more chance to control a fire in case one should start. Hollow spaces in walls and floors were eliminated, producing what is now known as an open joisted construction, and brick was substituted for frame in the walls of all of the larger buildings.

This type of construction was gradually replaced by what is known as standard mill construction, and practically all cotton mills built within the past twenty or thirty years are of mill construction. A standard mill constructed building has brick walls, heavy plank floors, at least 5 inches thick, supported on large single stick timbers spaced 8 feet to 10 feet apart, forming a bay construction. Reinforced concrete has not yet been used to any appreciable extent in cotton mill construction, but some large mills which are now projected are to be built of this material. This type of construction is undoubtedly an improvement over the standard mill type, and if generally adopted would prevent large losses. It would not, however, reduce the insurance cost as much as might be supposed at first thought.

The reason is that at the present time the principal items in a vast majority of fire losses in cotton mills are damage to the stock and machinery rather than to the buildings, the present systems of fire protection being adequate to confine the fire to a small area and prevent its reaching an intensity which will seriously damage the buildings. In cases where large losses in cotton mill fires occur, involving serious injury to or total loss of the buildings, the reason is found in a crippled fire protection system, that is, water shut off or an inadequate supply available at time of fire. The special advantage, therefore, of fireproof construction is confined to the case where for some reason the fire protection system failed wholly or in part to perfom its functions. As these cases are comparatively very few, and damage to buildings forms such a small part of the total cotton mill loss, the adoption of a fireproof construction will not very materially reduce the fire cost.

Here then we see the influence of insurance on construction, which has resulted in a steady improvement in cotton mill buildings until they have now become representative of the very best in building construction for manufacturing purposes.

ARRANGEMENT OF MANUFACTURING PROCESSES.

The second item to be considered is the influence of insurance upon the arrangement of the manufacturing processes. In the earlier stages of cotton manufacturing no attempt was made to separate the several processes. All were carried on in one building, frequently with no divisions whatever, and sometimes with wooden partitions to separate one department from another.

As there is a great difference in the manufacturing hazards in the different cotton manufacturing processes, this lack of segregation made the hazard of the entire plant the same as the hazard in the most hazardous department. It was readily appreciated by the insurance and cotton mill interests that a proper segregation of the hazards would very much reduce the insurance cost. The first step was to separate the pickers from the other manufacturing processes, and carry on this operation in a detached building or a section of the main building absolutely cut off from the rest of the plant by fire walls. Later steps separated the carding and spinning from the weaving department, and in mills producing colored goods the dyeing and finishing departments were cut off from the balance of plant. For quite a long time after this no further segregations were attempted, but during the past twenty years, more especially during the last ten years, a further sub-division has been made by providing a separate room or building for the opening process. In the vast majority of cotton mills at the present day the opening room is detached from the main building, or, if attached, separated therefrom by a good fire wall. This segregation of processes renders it possible to confine the fire to any portion in which it originates, and if unable to extinguish it, to prevent loss of more than one department or section of the plant.

THE PROCESSES IMPROVED.

The third point in cotton manufacturing which has been influenced by fire insurance is the processes themselves. With a view to reducing the hazards and also the insurance cost, many formerly hazardous operations have been changed and new methods of doing the work devised, so as to minimize the chances for fire. This is more especially the case in mills engaged in manufacturing goods which require the employment of dyeing processes. Many colors which formerly required the use of hazardous chemicals in their production are now rendered entirely harmless by reason of the discovery of new chemical processes for producing these colors. The drying processes especially have been changed and improved, the old fashioned open table dryers now being almost entirely displaced by machine dryers which handle the stock more expeditiously and safely.

Perhaps in no department have there been greater changes in processes than in the picking department. Here it was formerly the practice to open up large quantities of cotton and maintain large piles of same in the picker room, this stock being fed to the machine by hand, and scattered more or less thickly over the floor in so doing, so that if a fire originated it would almost instantly spread all over the room and by reason of the large quantity of combustible material prove very difficult to handle. In most of the larger mills it is now the custom to keep the piles of loose cotton outside of the picker room and feed the machines by mechanical devices, consisting either of blower systems or belt conveyor systems. Fires originating under these conditions are confined generally to the machine in which they originate, and are usually controlled with comparatively small loss.

IMPROVEMENTS IN MACHINERY.

The fourth point in which insurance has influenced cotton manufacturing is seen in some of the improvements which have been made in cotton manufacturing machinery. Insurance has exercised a smaller influence in this respect than in any one of the others already considered, for the reason that certain operations have to be performed on the cotton, and these can only be performed by fixed methods. Quite a number of minor changes, however, have been made in machines, tending to reduce the possibility of fire. For instance, better oiling devices, changing the location of bearings so as to remove them further from combustible stock passing through the machines, and the enclosing of certain parts to prevent the escape of dust or cotton flyings, and thereby causing the mill to be kept cleaner.

GENERAL FIRE PROTECTION.

In considering the effect of fire insurance upon cotton manufacturing we must not overlook the very important and essential feature of fire protection. As cotton manufacturing was the first hazardous industry to reach such large proportions as to necessitate action in regard to reduction of hazards as a means of reducing the insurance cost, so the cotton manufacturing industry was the primary cause of the introduction of fire protection systems. In the subsequent development of these fire protecting devices to their present state of efficiency nearly all manufacturing and insurance interests have contributed.

The earliest scheme of fire protection consisted of standpipes in the mill buildings, with hose attached to protect each department or floor. These standpipes were supplied with water from pumps, *usually rotary,* located in the basement or wheelhouse of mill, or from private or public reservoirs: The next stage of development was the installation, in the most hazardous departments, of a system of iron pipes pierced with numerous holes. These pipes were fed by steam or water and started from some central distributing point, usually the engine or boiler room, where each pipe was controlled by a manually operated valve. Both of these systems required the presence of one or more men to render them of use, and while helpful, they were lacking in efficiency, and also possessed the disadvantage of wetting down not only the area involved by the fire but a large additional area, thereby very largely increasing the water damage loss.

From this stage it was but a short step to the automatic sprinkler, which up to the present time has held first place among fire protection devices. Since the automatic sprinkler was invented there has been no change in the principles of fire protection. Progress has been along the line of development of details, such as improved construction of the sprinkler head, working out of most suitable methods of installation in different types of building construction, and arrangement and volume of water supplies.

In conclusion the following table is presented as embodying in concise form a summary of the principal causes of fires in cotton mills and the remedies therefor:

Principal causes of fires in cotton mills.		Foreign substances in stock.
		Hot bearings.
		Drying processes.
		Dyeing processes.
		Breaking of, or faulty adjustment of machinery.
REMEDIES.	Preventive.	Care and cleanliness.
		Outside opener room, with suction conveyor system.
		Use of safety matches by employees.
	Curative.	Segregation of processes.
		Slow burning or fireproof buildings
		Installation of automatic sprinklers.
		Hydrants and hose.
		Thorough distribution of casks and pails.
		Chemical extinguishers.

CLOTHING MANUFACTURE.

A Review of the Processes and Fire Hazards Attendant Thereto—The Importance of This Class of Risks to Underwriters.

By Edward R. Hardy, Assistant Chief of the Rating Department of the New York Fire Insurance Exchange

It is a far cry from the leaves which were worn in the Garden of Eden to the clothing produced in a modern factory

THE IMPORTANCE OF THE INDUSTRY

is well illustrated by a recent publication of the census dealing with thirteen industrial districts in the United States. These industrial districts were New York, Chicago, Philadelphia, Boston, Pittsburgh-Allegheny, St. Louis, Baltimore, Cincinnati, Cleveland, Buffalo, Minneapolis-St. Paul, San Francisco and Providence. The value of the products of the clothing manufacturers in these industrial districts where the volume was sufficient to be enumerated was as follows:

New York	$310,000,000
Chicago	65,000,000
Philadelphia	31,000,000
Boston	18,000,000
St. Louis	8,500,000
Baltimore	22,000,000
Cleveland	10,500,000
Buffalo	4,750,000
Minneapolis-St. Paul	2,500,000
San Francisco	5,000,000
Total	$477,250,000

Thus in the ten industrial districts the total value of the products produced was $477,250,000. Without doubt the industry amounted to $500,000,000 in the United States, or practically one-sixtieth of the total insurance business written for the year, taking it, as reported, at $30,000,000,000.

In two of the industrial centres, viz., New York and Baltimore, it is the leading industry. In New York the product amounted to something like 14 per cent. of the total manufacturing business of the district.

Ancient as the art of making clothes is, the clothing factory is probably not much over one-half century old. Clothing previous to that time was made either by the strolling tailor in the country districts, in the home itself, or in the ordinary tailor shop. The custom tailor has almost passed away. He is a tailor who does not carry any stock of cloth, but merely carries the patterns and samples of cloth from which the desired suit is chosen. The merchant tailor, on the other hand, differs from the custom tailor in that he carries the cloth in stock and is thus able to show the goods in the piece and not merely from the sample after the manner of the custom tailor. In the country districts the strolling tailor, like the strolling shoemaker, would go from house to house and from their own cloth make up the clothes which were wanted. All this has passed away, and the manufacture of clothing has become as great an industry as almost any in the world. A brief visit through a clothing establishment will perhaps furnish us as good an idea as any of the

PRESENT METHODS OF MAKING CLOTHES.

When the cloth is received in the piece it is first compared with the sample from which it was ordered to see if there is an agreement. If there is, it is then carefully examined in a good strong light for the purpose of discovering any defects which may exist, these defects being indicated by different colored tapes, which are attached to the cloth where the defect is found. If it stands the examination test it is then, in the best shops, sent out to be shrunk, unless the shrinking is done on the premises. In the better class of factories the shrinking is carefully looked after. The cloth is not accepted as shrunk, but in order to secure absolute reliability the factory has it shrunk for itself.

On returning from the shrinking, the cloth is again compared with the sample and graded accordingly: A, B, C, etc. Assuming it to pass the test thus far, it is then turned over to the cutters in the cutting department. The cutters are not specialists in the sense that we shall find the makers to be, but will cut any portion of the garment, as the trousers, the vest or the coat. A lay of cloth, as it is called, is the cloth when spread on the cutting board all duly chalked according to the pattern outline and ready for the cutting.

MECHANICAL CUTTERS.

In the making of cheap garments an electric or mechanical cutter may be used, but in the making of the better garments—the very highest grade—this is not possible. It is possible for this mechanical cutter to cut about four thicknesses of cloth, that is, the outer cloth of a suit, at any one time and to do reasonably good work. Any increase beyond this is apt to lead to deficient work.

In the case of linings of the stiffer character a large number of pieces can be cut by mechanical means and done very satisfactorily.

After the cloth is cut for the garment, all of the pieces for that garment are tied up in one bundle, and are sent to the trimming department. This department includes everything else that goes into the making of a suit of clothes, except the outer cloth—buttons, braid, lining and every possible thing are embraced under the general term "trimming." All that belongs to a suit of clothes are then attached to it, and the entire bundle is sent to the making department.

SUBDIVISION OF LABOR.

In the making department specialization at once begins. The work is minutely subdivided, each sewer or laborer who handles the garment is a specialist in the sense that he or she does nothing else. It may be the sewing of buttonholes; it may be basting the garment, or sewing the pockets or attaching the pockets, or sewing on the collars. Whatever it is, the work is done and the garment passed from one to another until it is finished. In the better grade of establishments those parts of the garment which fit over curved portions of the body are sewed or manipulated over curved tables and not on flat ones. This establishes at once the curved outline in the garment, and tends from the very beginning to make it a better fitting piece of work than would be the case if it were made from or on flat tables entirely.

The amount of work that can be done on a machine is, of course, extremely extensive; at the same time the use of hand labor to a large extent—an extent far more than is generally imagined—is necessary in the better grade of work. The machine in first class work can only go so far. Hand work must be brought in where good work is to be turned out.

PRESSING.

After the garment is completed, so far as the manufacturing is concerned, it passes to the pressing department, and here again the feature of specialization is introduced, one presser being skillful with producing the proper effect on one part of the garment as the collar, while another may press the sleeves or the body. A majority of the pressing is done by hand, the ordinary tailor's iron being used, but machine pressing is used for the garment, i. e., those parts of the garment where there is extra padding or thicknesses

This machine produces a pressure of about 1,600 pounds on the garment. The table on which the garment is laid when pressed by this machine is warmed to about 200 degrees, and is cloth covered, while the iron which is applied to the top of the garment is heated to a somewhat higher degree, between 300 and 400 degrees. It can be readily seen that the force of this pressure is sufficient to flatten out or shape most any garment that is placed beneath it.

After being pressed and completed, so far as the manufacturing is concerned, the garment may be said to be finished, and the next stage in the operation is to pass the garment to the examining room, where it is carefully gone over in a most minute manner to ascertain if it corresponds with the order given or if any defect of workmanship has occurred.

When the garment started as a piece of cloth there was attached to it a large card containing spaces where each worker who performed any work on it could make a notation. Hence, if a defect is discovered it can readily be traced to the person who is responsible therefor.

FROM THE INSURANCE STANDPOINT.

The entire business of garment manufacturing is not profitable, with the exception, possibly, of the sole tenant risks. But these are the exception, and the great majority of clothing manufacturing is done in multiple occupancy risks, and the record of garment makers is a loss ratio or loss cost altogether beyond the profit line. Various explanations may be put forth for this, but none possibly are fully satisfactory. Whether the classifications are sufficiently minute to show as to which form of garment manufacturing may be the best loser is doubtful. In all probability the run of classifications falls into one group, and would include every form of wearing apparel that is made. Thus it is possible that if minuter classifications were kept distinguishing between the making of men's garments, women's garments, cloaks and suits as distinguished from shirt waists; in other words, if classifications would show separately the more permanent forms of wearing material from those which are more dependent upon style, the bad loss record might be traced to certain groups in the business rather than to the business itself as a whole.

THE HAZARDS INVOLVED

are certainly not such as to cause any serious concern. The heat necessary for pressing purposes can be well guarded; benzine is not required except in small quantity to remove a stain in case a garment may become spotted.

Undoubtedly the general pressure under which the work is done and possibly the number of the employees that are engaged in the business, the difficulty of keeping, except the best establishments, in clean condition, all contribute to favor the high loss ratio. There are few establishments, of course, where all of the work is done under their own roof. A large part of the clothing business is still scattered throughout small establishments or factories, as they may be termed. It is a business in which the piece worker, whether in the factory or home, predominates.

The so-called sweatshop, as such, has nearly passed away. In the light which has been focused upon it, the general tendency to improve hygienic conditions and the high or abnormal rate of insurance charged such establishments are having a tendency to remove the sweatshop, so called, from the face of the earth.

In conclusion, it may be noted that there are over fifty processes in the making of a garment, taking it from the time the cloth is picked up until it is turned out and ready for the wearer's back. These fifty processes, of course, all involve about the same degree of hazard excepting the pressing department, where the heat is concentrated. The gas iron is being displaced to an extent by the electric iron, but the latter is still more expensive and probably on the whole is not much safer. if any, than the gas iron, several fires having occurred where the current was left on when the iron was left standing on the holder It is a most interesting business, and when we reflect that it is furnishing apparently one-sixtieth of the entire risks assumed in the United States, its importance to the underwriter can be readily understood

SOAP FACTORIES

Misapprehensions—The Ideal Factory—Processes and Materials—Products and By-Products—The Fire Hazards.

By Edwin O. Torbohm, Inspector for the Home Insurance Company, of New York.

Unfortunately for the soap maker his business is associated in the minds of most fire underwriters with grease extraction and fat rendering, processes which are rarely a part of the modern establishment. Likewise the treatment of waste lye to recover the contained glycerine, which by distillation furnishes the material commonly known as "dynamite crude," awakens, in the minds of some, vague apprehensions of the hazards attending its ultimate state—nitro-glycerine.

Few industries have undergone the improvement in physical condition that has characterized the manufacture of soap in recent years, the up to date establishment having little in common with its prototype of a generation ago. It is true that such modern features as box making, label and pamphlet printing and the handling of "premium goods" have been introduced, but the straight soap works is essentially a better risk than its forerunner in every respect, and clearly entitled to recognition as such from the fire insurance interests.

CONSTRUCTION AND ARRANGEMENT.

No definite rule can be laid down for proper construction and arrangement, the varying needs of different factories determining this quite independent of fire insurance opinion. The ideal soap factory, like the ideal in other classes of risk, will be found to consist of a number of buildings, low in height, with ample spaces separating the various sections, or, if these adjoin and communicate, cut off by standard fire walls and doors. Most of the newer plants are of improved forms of construction, either full mill type or approximating the same where not of fire resisting design. Segregation of the manufacturing operations from the stocks of raw material and the stocks of finished goods not only minimizes the possibility of serious interruption of the business through total destruction of the plant, but reduces the fire insurance cost

Many ordinary risks remain, however, or form the nucleus around which the better buildings have been erected, and the best that can be expected of these is that they shall be adequately cut off by efficient fire stops. When confined to a single building the operations are either on a very limited scale or the hazard is materially increased by reason of the resultant congestion.

In the boiling buildings soap kettles not infrequently extend through two or more floors, which may at the same time be further cut for an over-average amount of piping. Where the necessary stairways, elevators and similar floor openings are properly enclosed it is important that the spaces just mentioned are stopped as well as may be. Although small in many cases, they readily permit the passage of smoke and flame to upper floors. Wooden ducts through the floors for the passage of steam or other vapors should be avoided, and chutes for the delivery of dry material from floor to floor (found more frequently in the older type of risk) should, where possible, be trapped at each floor and constructed of heavy incombustible material.

SOAP AND ITS CLASSES.

The manufacture of soap is in reality a chemical process, various fats and fatty acids being combined with alkalies in the formation of a new compound valuable through its power to assist in the removal of grime and grease. The product may be, and frequently is, diverted from its original purity and strength through the excessive use of adulterants, but never entirely loses its detergent powers.

Roughly speaking there are two chief divisions in soaps, viz., hard soap and soft soap. Hard soaps are made usually with a soda base and contain little moisture, while soft soaps, with potash as a base, do not readily give up their contained moisture, and being made mainly from the fluid or semi-fluid vegetable oils, remain in a state of paste or jelly. Soft soaps are used almost exclusively by manufacturers, as in the woolen industry.

RAW MATERIALS.

The raw materials used in soap manufacturing include various vegetable oils, notably olive, cottonseed and cocoanut oils; animal fats, such as tallow; alkalies, caustic soda (also known as soda ash or carbonate of soda) and carbonate of potash. To these must be added salt and unslacked lime, rosin and various fillers, such as silicate of soda (soluble glass), sal soda and borax. Perfumes and colors are used to a limited extent in common soap, but more extensively in toilet or fancy soaps. As adulterants clay, silicate, ground quartz and similar materials are employed.

PROCESSES.

According to the process of manufacture there are four main divisions in soap making, viz., boiled soap, semi-boiled soap, soaps made under pressure and cold process soap. As probably 90 per cent. of the soap manufactured in the large establishments is hard soap, the various operations necessary to its production will be described very briefly as follows.

BOILING.—Melted fats are run into or pumped into large cylindrical tanks or kettles, usually constructed of riveted plates of steel and equipped with coils of steam pipes around the sides and with a stirrer or paddle near the top to keep the froth from boiling over. To these fats are added a strong lye solution (previously prepared by boiling caustic soda until the contained carbonic acid gas is released), the entire mass boiled for some time, common salt added and the material allowed to separate into two layers, the upper, a more or less perfect soap, in semi-liquid or pasty grained state, the lower, or waste lye, in a liquid state containing various impurities, salt and glycerine.

The waste lye is usually drawn off, fresh lye added with lump or powdered rosin, and the boiling continued. This alternate boiling, salting, settling and withdrawal of the waste lye may be repeated several times, until in its final state the soap in the boiling kettles separates into four more or less distinct layers. The lower of these is the spent or waste lye, the next, known as "nigre," being a form of impure soap; next above this coming the pure soap, occupying about four-fifths of the entire space, and upon the top a thin layer of foam or fob.

CRUTCHING.—The crutchers are large iron kettles or tanks with open tops, into which the pure soap is pumped, and while being agitated by revolving paddles the fillers, legitimate and illegitimate, are added, together with such color or perfume as may be desired.

FRAMING.—From the crutchers the soap is run directly into the soap frames, which consist of tall, narrow boxes of wood or iron usually mounted upon wheeled trucks. These are drawn aside to cool, an operation which unassisted requires from three to four days.

CUTTING.—When sufficiently cooled to handle the frames are stripped of their movable sides and ends, leaving a block of solid soap. This is cut into flat slabs by wires drawn through the block, the slabs are cut into bars, and the bars into cakes, as may be required.

DRYING.—Placed upon trays mounted upon wheeled platforms the bars or cakes are dried in enclosures heated by steam or blown air, and are then ready for the finishing operations of pressing, stamping, wrapping and packing for shipment, the three first mentioned of these operations being now largely done by machinery.

SEMI-BOILED SOAPS.—These contain all the raw materials used, and are for washing powders or similar cheap products. They are much less carefully made and usually with only two boilings, one for the saponification of the materials and one for settling.

SOAPS MADE UNDER PRESSURE.—Boiling by steam at pressures from 200 pounds to 300 pounds is used. The saponification is quickly effected, and the process is economical of both time and material.

COLD PROCESS SOAP.—Usually processed by pumping liquefied fats to crutchers, mixing here with the alkali and fillers and completing the saponification in the soap frames. This type also contains all the materials used.

TOILET SOAPS.

These are now made by what is known as the continuous process, a system which has done away with much of the labor and cost of former times. A good grade of pure hard soap fresh from the kettles is run upon a set of rolls cooled by water, and, passing through these, is delivered in the form of narrow ribbons of soap upon an endless apron or carrier, the thin sheet from the rolls having been cut by a set of knives under or in front of the rolls. The carrier is enclosed in a box or room usually of wood with glass windows. Here the soap ribbons are rapidly dried by being subjected to the heat of steam coils or blown hot air, and pass to the milling machines. In these the soap chips are passed through several sets of rolls, coloring matter and perfumes added and finally reach the plodder, a long cylinder fitted with a plunger. Through this plodder the soap is pressed, emerging at the delivery end through a small opening as a long narrow bar. This bar is cut, pressed, stamped, wrapped and packed, the individual cakes generally skin hardened by an application of alcohol to the surface before wrapping.

OTHER SOAPS.

NAPHTHA SOAP.—This is a cold process soap in which naphtha is mixed with the melted greases and rosin, the alkalies added, saponification being effected in the frames. As considerable heat is evolved from the process of saponification some of the naphtha is necesarily volatilized, but there is little loss after the soap has thoroughly cooled and is wrapped.

MARINE SOAP.—Also a cold process soap for use in salt water. Usually made with a considerable percentage of cocoanut oil and very strong lye.

GLYCERINE SOAP.—Another cold soap, to which glycerine and sugar are added.

TRANSPARENT SOAP.—This soap is made of tallow, olive and cocoanut oils, with caustic soda dissolved in alcohol, which upon evaporation leaves a hard transparent soap.

MEDICATED SOAPS.—These have a base of pure hard soap, to which is added carbolic acid, pine tar, sulphur and similar materials.

Washing Powder.—Washing powders are rarely made from soap, but are mechanical mixtures of soda ash, some soap powder, and occasionally may contain fine sand and adulterants.

Soap Powders.—These are made from absolutely dry chip soaps ground into a fine powder, with or without the addition of other materials, depending upon their grade and the uses to which they are to be put.

Scouring Soaps.—Also known as sand soaps. Made from a more or less pure soap by adding fine sand, ground quartz or other abrasive material.

Axle Grease.—This is essentially a soap, made with rosin oil and lime, a higher grade containing properly saponified fats, usually tallow and palm oil, with carbonate of soda. In the lower grade grease, graphite, heavy petroleum oils, etc., are sometimes included. Both are made without boiling.

Floating Soap.—Soaps of ordinary nature are made into floating soaps through violent agitation to incorporate a large volume of air in the product.

GLYCERINE RECOVERY.

What is now a very important by-product was formerly ignored by the soap manufacturer in the waste of the spent lyes, these being allowed to run away; whereas at the present time in all large establishments they are pumped to a department known as the glycerine refinery, and through special treatment their valuable content is recovered.

Very briefly described the process consists of the following:

The impurities in the spent lyes are precipitated by a treatment with nitric or sulphuric acids, the alkali neutralized by the use of sulphate of alumina of iron and muriatic acid and passing through filter presses, which remove all remaining undissolved impurities, the liquid is carried to large steam heated cylindrical evaporators. Here the salt is dissolved and removed by filtering, crystallizing and settling in the shape of glauber's salt (sulphate of soda), or the salt may be removed through the use of an hydro extractor. After the elimination of the salt evaporation of the cleared liquor is carried on until crude glycerine is obtained, and this by steam distillation yields the "dynamite crude."

Beyond this stage few soap factories go, the subsequent proccases being carried on under vacuum in special refining stills heated by live steam or direct fire heat, or both, successive distillations yielding relatively purer and lighter tinted stock up to the chemically pure glycerine, which is made practically colorless by filtration through bone-black.

HAZARDS.

Contrary to commonly accepted belief there are few special hazards connected with the manufacture of soap in the modern way. The rendering of fat or hotel kitchen refuse is not a necessary element of soap manufacture, and is combined with it only in certain low grade establishments. The use of fire heat has been effectively superseded by steam, and even the wood lagging formerly used about the boiling kettles (in itself a relatively small source of danger) is disappearing.

Drying of the finished stock is at low temperatures, usually by blown air from steam coils or directly from steam pipes contained within the drying enclosures. The common hazards of heating and lighting are as readily amenable to regulation as in other types of manufacturing risk, excepting perhaps that the corrosive effect of vapors in some portions may more seriously affect electrical equipments and iron piping.

Of the incidental hazards—the storage of wooden box shooks, box nailing and label printing, as well as paper box making—none are especially severe, and all are too well known to warrant extended description here. The storage and shipment of premium goods, now quite common, adds a noticeable element of danger in those establishments where proper attention is not given to packing material or where repairing of these goods is attempted.

In the quantity and quality of some of the raw material used in soap works there lies undoubtedly the greatest single element of hazard, an element certainly much greater than is present in any one of the manufacturing processes, if indeed in all of them combined. Large quantities of fats and fatty material, both of animal and vegetable origin, are required in the business, and whether these be kept in the original packages or bulked into special storage tanks, their presence in case of fire cannot fail to be disquieting. Likewise there are immense quantities of rosin in barrels in or about most soap works. The extent to which these two classes of raw material expose the main values is relatively of very great importance. The more nearly separate and distinct they are kept from the manufacturing operations the more likelihood there is for a partial loss only in case of fire, while with their bulk converted into fuel exactly the opposite is true. For rosin at least the ideal condition of storage would appear to be in yards or similar outside spaces. Where large tanks of oil or liquid fats are maintained within important buildings it were expedient to suggest that some means of draining the material from the tanks in case of fire be installed. Also some thought should be given to the undesirability of storing large quantities of liquid fats or oils upon levels much higher than the manufacturing or other important sections.

The rate of combustibility of soap or the materials while in process, is not rapid. Once fairly under way a soap works will burn with a degree of freedom surpassing many other risks less favored in initial hazard, but there is little about the actual processes to induce ignition and less inherent combustibility in the final result than might be presumed from the nature of the raw materials which enter into its composition The storage of large quantities of naphtha soap might perhaps under certain conditions fill a warehouse with a dangerous quantity of naphtha fumes, but such soap carefully made and properly handled does not exhibit these tendencies, and the danger is probably remote

Where the manufacture of perfumery, facial creams and other toilet preparations is combined with toilet or other soaps an added hazard due to the volatility of essential oils and alcohol is again present, but its severity is also largely dependent upon the extent of the operations and the care exercised in their conduct

Glycerine heated to a high degree is said to give off a gas which is disagreeable to the nostrils, and this feature should possibly receive some consideration in connection with the care of filter press cloths and disposal of animal charcoal if used. Otherwise the hazard of glycerine recovery appears to be mild.

FIRE EXTINGUISHING EQUIPMENT.

To the large soap works steam under high pressure is a necessity, and for such the installation of an efficient fire pump with standpipes, if necessary, and sufficient hose to properly protect all parts, should be insisted upon The humble fire pail must not be overlooked, however, and both water and fine dry sand provided, the latter more particularly at or near the points where grease, oils or fats are freely used. Chemical extinguishers have perhaps less value in some portions of soap works than in others, owing to the corrosive effect of vapors. The same holds true of automatic sprinklers, which, while very important and valuable in all ordinary sections, are quite likely to be seriously impaired in such places as over the lye tanks. The efficiency of sprinklers may be questioned, and the amount of attention a sprinkler system needs may be relatively much greater in a soap works than in many other types of risk, but their installation should be persistently recommended. Outside hydrants with hose will commend themselves where the plant is much spread out or the public protection is inadequate.

METAL WORKERS.

The Hazards of the Tin and Copper Smith's Industry, With Suggestions as to Improvements in Conditions as They Frequently Exist.

By Charles C. Dominge, Insurance Engineer, New York City.

The subject of metal workers in general has appeared from time to time in numerous insurance publications, each article bearing the signature of an expert. I feel that nothing material can be added, but by confining ourselves to that small subdivision of the general class of metal workers, i. e., the tin and copper smith industry as it relates to the manufacture of lanterns and automobile lamps, we may within the limits of this article glean a few pointers as to the hazards to be found and how best to guard against them.

PROCESS OF MANUFACTURE.

Following the various stages of manufacture we find first the cutting of the sheet metal into the various pieces which are later to be worked into shape. Most of the work of cutting, as carried on in the "up to date" metal worker, is done by heavy stamping presses, with cutting and forming dies which stamp out pieces of metal of the required size and shape with fair rapidity.

The flat metal pieces are then worked into shape by hand or by special machines. A gas heated furnace is used for the annealing of the metal, or a blowpipe or brazer is used for softening the metal preparatory to working it.

The brazer consists of a flexible tube carrying gas from a supply pipe to a nozzle which is attached to another flexible tube through which the operative directs a stream of compressed air. This stream of air serves the double purpose of intensifying the heat of the gas flame and blowing it with force against the metal surface to be worked.

After working the flat metal into shape the several parts of the lantern are assembled and taken to the soldering room. A soldering furnace supplies the heat necessary for the irons or soldering coppers. This furnace may be found in varied types, but is usually in effect a single burner gas stove of unpretentious or "muffler" design, burning illuminating or gasoline gas mixed with air after the Bunsen principle. In the tinsmith shops in rural districts or small towns they use the old fashioned soldering furnace burning charcoal, sometimes called "Salamander," or they may use a gasoline soldering furnace.

After leaving the soldering room all that remains is the finishing, polishing and putting on whatever finishing touches are necessary before the article is ready for market.

The lacquering consists of coating the articles with a varnish-like lacquer or japan, after which they are placed in a dry room or oven in a temperature of about 150° to 175° of heat, where they are left until "baked."

Ordinary tinware is frequently polished in a tumbler This is a large barrel placed horizontally, with a bar through the centre which allows the barrel to turn on its axis The barrel is partly filled with sawdust, into which the tinware is thrown. This device revolves slowly, throwing or "tumbling" the articles about in the sawdust until they receive some polish. Brasswork is polished usually on buffers, which are rapidly revolving wheels made of many layers of cotton cloth pressed together

THE HAZARDS OF MANUFACTURE.

The hazards involved in the foregoing processes are almost self-evident. The stamping presses, where the metal is first cut. present no particular hazard in themselves except that of dripping oil and oily floors. Cleanliness and a proper self-closing receptacle for oily waste will guard against danger here

The presses should be set on metal bases with curbed edges to prevent oil from running on floor Drip pans under bearings should also be provided. A case was recently noted where owing to the nature of the machine and the special work it did a light was necessary in an unusual position almost inside the machine. Instead of an incandescent light with wire guard an open gas flame was used, and oily drippings were a menace. Annealing furnaces should be set on solid brick bases, as recommended by the underwriters.

The brazer requires special attention. Owing to the nature of the work it is impossible to have a rigid gas pipe connection to the supply pipe. A substantial cloth insertion tubing of heavy texture with a strong end coupling should be insisted upon, unless the underwriters in the meantime approve flexible metal tubing (at present found wanting in a number of respects, such as leaking, etc.). There are two stop cocks, one controlling the supply of gas and the other the compressed air supply—one pair on the blowpipe for convenient control of the operator, and one pair at the permanent metal supply pipe. Should trouble occur necessitating the extinguishing of the flame the supply of gas should be shut off at the main stop cock—*not at the blowpipe.* The flame of the brazer plays continuously whether the compressed air is being used or not. An operative may lay down the blowpipe for a moment or so and the flame coming in contact with woodwork would prove disastrous. Therefore it is necessary to have a solid metal base or the bed of a forge for the operating table, and all woodwork in close proximity should be protected with metal, with at least an inch of air space, as metal laid directly on wood is a bad feature owing to the heat carbonizing the wood. Flooring should be non-combustible. It is found desirable to provide a metal hook pendant from the ceiling, upon which the blowpipe is hung when not in actual use.

SOLDERING FURNACES.

Soldering furnaces should be securely fastened to a solid metal base and have legs at least 6 inches high, and the gas supply pipe should be of rigid metal. Flexible tubing is dangerous and is not approved by the underwriters except for movable devices, such as brazers, etc. Woodwork in the soldering room should be protected as above.

Iron filings and turnings, which are made in the machine shop section, although not usually considered dangerous, have been known to cause spontaneous combustion. If allowed to accumulate on the floor, especially in a heap, where water may be thrown on them, as in the case of a porter sprinkling down the floor, an amount of heat is generated by rapid oxidation sufficient to produce combustion, particularly in oil soaked sweepings, lint and waste. It is a common occurrence for the foreman or a mill owner to visit the machine shop at night and in a dark corner see blue luminous shivers of flame arising over a heap of iron chips or filings.

JAPANNING AND LACQUERING.

The process of japanning, or applying the lacquer, whether by means of a brush, a spray or dipping, should never be carried on near an open gas flame. If electric light is not available an enclosed glass lantern similar to a porch or stable lantern would be the next best thing. Applying by brush is considered the best, as it prevents dripping to a certain extent and keeps the operative continually watching. Methyl or wood alcohol, fusel oil, acetone, turpentine, benzol and other volatiles should be stored in a separate building detached from main risk, or else in a fireproof vault. Only a day's supply should be brought into a building at a time. Dipping tanks, if used, should be provided with automatic covers and have a drain pipe, so that the tank may be drained each evening, or in event of emergency to a proper receptacle outside of building. Spraying devices usually scatter the lacquer all over and are not recommended. Wherever this work is done pails with scoops, filled with clean dry sand, should be provided, as this *has been found to* be the best of extinguishers, smothering a fire.

OVENS AND DRY BOXES.

For drying small parts and in some of the smaller concerns they use what is known as a lacquer dry box. These small boxes are usually built of sheet iron on large metal uprights and are heated by gas. If steam instead of gas is used they are quite safe. For large work the oven is used. This should be constructed of at least 12 inch brick side walls, with an 8 inch brick arch floor and roof on steel beams, and have a standard or an angle iron door at the opening. The heating must be by steam. A vent should be provided, same to enter a brick chimney to be used especially for this purpose. Direct fire heat should never be used on account of the volatile vapors which form in these ovens. Lights, if any, should be incandescent electric with keyless sockets and wire guards.

POLISHING.

The "tumblers," or "rumblers," as they are sometimes called, present but little hazard. Ordinary cleanliness about the floors and covered waste receptacles is the best precaution. If oily stock is "tumbled" there is danger of fire from spontaneous combustion due to oil soaked refuse material, waste or sawdust, and same should be removed from building.

BUFFING.

The buffing process is the most hazardous of all on account of the liability of spontaneous combustion. A very fine dust or lint is thrown off the buffers in this process. This dust is very hazardous, as the buffing wheels are in many cases saturated with oil used in polishing, and if allowed to fall to the floor, or accumulate in corners where oil or grease may be, it becomes an easy source of spontaneous combustion. In most plants a small blower system empties the dust into a barrel about half full of water located in a metal lined room. A standard condition would call for a blower system similar to that used in woodworking establishments, only of course on a smaller scale. The blowers should lead directly on the outside of building to the roof, discharging their contents into a "cyclone" or separator, whence an outside duct carries the lint to a fireproof vault (with vent) detached at least 5 feet from main risk. Inspectors should satisfy themselves that there are no defects in the system, and should follow same from start to finish. Some blowers empty into frame rooms in the basement, while others feed direct to furnaces. This latter practice is a bad one owing to back draughts; the former condition should be eliminated. *Blower pipes must not pierce floors.* The buffing room should be cut off with at least a 12 inch brick wall, parapeted and have a standard automatic fire door at the opening to the plant. All open lights, shafting and belting should be removed. Incandescent lights with wire glass enclosures should be the only light permitted. Emery wheels should never be permitted in these rooms. Fires have been caused by the nails in the shoes of the workman striking against the metal covered floor and sparks communicating with the thick dust or lint.

BENZINE CLEANING.

In some factories benzine is used to clean metal of grease, oil, etc., previous to working, also for cleaning dies and machinery. The use of benzine should be discouraged and kerosene, lyes and soap used instead.

ACIDS.

Some acids are used for soldering, cleaning, plating, or perhaps pickling. Care should be taken of nitric acid, as the same is liable to ignite fibrous material which it may come in contact with. Supply of acids should be in a vault and reduced to a minimum, as in case of a fire it retards the progress of the firemen. If "killed acid"—made by dissolving zinc in hydrochloric or muriatic acid—is used, it should not be made inside the premises, as a large volume of hydrogen is given off during the combination, with the danger of same becoming ignited either spontaneously or otherwise.

TESTING.

After a gas lamp is entirely finished it is brought to the testing room, where an acetylene generator with a rubber tube is attached to the lamp to see that it is perfect. Calcium carbide should be kept in waterproof, airtight receptacles.

INCIDENTAL HAZARDS.

If the stock is packed on the premises a standard lock-jointed bin should be provided, and all surplus packing material should be stored in a fireproof vault.

The making of wood boxes or crates should be done in a cut-off section or in a separate building.

IN CONCLUSION.

By following these precautions the chief hazards which I have endeavored to point out will be materially lessened, and with proper fire pail equipments, standpipes and watchmen service a metal worker of this class will be found a desirable risk.

PAINT AND VARNISH FACTORIES.

A Survey of the Fire Hazards Prevalent in This Class of Risks—Suggestions for Improvement in Conditions.

By Alfred G. Patton, Chief Engineer and Chief of the Rating Department of the New York Fire Insurance Exchange.

To compass in a single paper a composite description of the paint factory as its exists today, with its attendant and consequential hazards, would be almost an impossibility. We can only hope to cover some of the more apparent and glaring hazards in the limited space which is allotted to this article.

There are two elemental factors entering into the construction or manufacture of paints which we will consider first, namely, leads and oils.

PREPARING THE LEADS.

First as to leads: The ordinary blue lead as mined from the earth is well known in its purified state to almost everyone. The white, yellow and red leads are prepared from the blue lead in different ways.

In manufacturing white lead the blue lead is melted in iron pots over direct fire heat and is run off in some instances into automatic molds; that is, molds that receive the lead and discharge the same molded into shape by mechanical means, these shapes being about the size of an ordinary man's hand and molded after the general pattern of a gridiron. After being cast into this shape the molded lead is packed in earthen jars with a small amount of diluted acetic acid and the jars are buried in layers in dampened tan bark, each layer being ventilated by wood shafts to the outer atmosphere, and by this means the proper temperature of the various strata or beds of the jars is maintained.

A period of about thirty days is permitted to elapse before the jars are uncovered, and the lead is then found to have corroded into white lead. This is detached from any small particles of the original blue lead which may still be left, the latter being recast for corroding. Throughout this entire process little or no hazard develops; in fact, outside of the proper setting of the lead melting pots no care need be taken, as the temperature of the corroding beds never rises to a point sufficient to warrant any hazard of fire.

In manufacturing the red and yellow lead the blue lead pigs ar merely thrown into a furnace heated to a given degree of tem perature by direct fire heat and air is forced through the lea while under this temperature. By means of this circulation c air through the lead the red and yellow oxides of lead ar formed The mass is kept well in motion by long iron poker and drawn off from the furnace at the proper time.

Other than the proper setting of the furnaces and the protectio and insulation of any woodwork or inflammable material in th vicinity of the furnaces, no precaution apparently is necessary i connection with this process of manufacture.

Red, yellow and white leads are reduced by grinding first i water and evaporated in large steam heated pans, which drive off the water The residuum from these pans is then ground i linseed oil to form the base of paints. In many plants ordinar whiting is added to the white lead during this process.

OIL MILLS.

The oil mills are, of course, one of the hazards of a paint factory, and great care should be exercised to keep them and th surrounding section of the building in which they are locate clean and in good order and entirely free from any accumulatio of oily material. It would be better if these mills could alway be located in a fireproof section of the plant. Care should b taken that the parts of the mills should be thoroughly cleaned an dried in the most painstaking way after using. They should neve be permitted to be dried in sawdust, as it is quite possible that small amount of oil would still adhere to the metal parts afte cleaning, which might impregnate the sawdust and cause spontaneous ignition by oxidization.

Oils may be divided into two classes—organic and inorgani oils. Organic oils are those which are derived from organic matter; that is, matter having life, either animal or vegetable; an inorganic oils are derived from matter having no life, such a mineral oils. It may be stated that in general the organic oil are oxidizing oils, while the inorganic oils are non-oxidizing. Th dangers of spontaneous combustion are present only in the oxidizing oils; that is, the oils will absorb oxygen from the atmosphere, and from the chemical affiliation of the oil and oxyge change from a fluid into a solid. It is because of this peculia factor of the organic oils that they are valuable for painting purposes. When absorbing oxygen the chemical reaction in the oi causes a rise in temperature, and when the oil which is undergoing oxidization saturates porous organic matter such as a piec of cloth, wiping waste, shavings, or sawdust, the heat is conserved in the pores of the material until the temperature reache ignition point and spontaneous combustion ensues. This, o *course,* is the great hazard of a paint factory and should b guarded against. Only such oils as will oxidize into a hard mass can be used for painting purposes. Mineral or non-oxidizing oils are valueless in this connection.

MANUFACTURE OF LINSEED OIL.

In making linseed oil the flaxseed is cleaned by means of screens, and is then warmed and crushed by steam rollers into a meal. This meal is packed in thick cloths made of camel's hair and placed in hydraulic or screw presses and the oil extracted by pressure. The oil is then run through the filter press by means of which all impurities are gathered into the mesh of a canvas sack, through which the oil is forced. The cost of the camel's hair pressing cloths is such that good practice demands that they shall be kept continually in use and never be allowed to dry out. There is therefore no danger of oxidization in connection with these cloths, for as soon as one press is completed the cloths are immediately put into requisition again for another pressing. The filter press canvas sacks, however, are a different condition entirely and should be very carefully watched, and should not be allowed to accumulate after having been used without being washed. It would be much better to wash and dry them outside the building if possible. Great care should be taken in drying the cloths. The cake-meal or the residuum from the pressing of the flaxseed has no bad qualities, and is not at all dangerous. It is generally shipped to foreign parts and used as cattle food.

Wherever oil is found on the premises, whether in the manufacture of paints or in process of extraction from the seed, great care should be taken that conditions be kept clean and orderly and entirely free from any accumulation of oil splash or waste.

BOILING THE OIL.

In boiling the oil another great hazard develops, and this should only be done in fireproof buildings outside and away from the general plant and under most carefully arranged conditions. Hooded kettles with metal carry-off pipes to flues only should be used for this purpose, and the fire should be so arranged that oil boiling over cannot possibly come in contact with it. This is done in many instances by having a fire in another room entirely and the bottom of the kettle only extending through a brick platform and exposed to the flame.

A good precaution is to build the fire on an iron truck so that it can be immediately drawn from underneath the kettle in case the temperature of the oil approaches the ignition point.

Occasionally in plants of this kind oil is oxidized for linoleum or similar purposes. This is done by flushing the oil over open work cheesecloth suspended from the ceiling of the room. These rooms should, of course, be isolated from the rest of the plant and built only of fireproof construction and kept under the most careful supervision when not in actual use. While they are being used very little danger is to be apprehended, as the oil is flushed over the cheesecloth several times a day, the drip being carried off in a drain from the floor.

CHROME COLORING.

The pigments used in coloring white lead present very little hazard except where chrome colors are manufactured on the premises. In many instances where these colors are made a nitrate of lead is used in the process of manufacture, and they are subject to spontaneous ignition owing to the well known inclination of nitrates to give off the oxygen under favorable conditions. Great care should be exercised in and around rooms for drying chrome colors on this account. The temperature should be watched closely and rooms only of fireproof construction permitted, well isolated from the plant. Great difficulty was met some years ago in textile plants owing to the spontaneous ignition of yarns dyed with chrome colors, and it was some considerable period before the real cause of the trouble developed, it eventually being discovered that the nitrates in the chromes caused the spontaneous ignition. This condition, of course, is liable to develop in any risk where nitrates are used, and explains why nitrates or chlorate bags should be very carefully excluded from the premises until thoroughly cleaned and dried. Prussian blue has been especially complained of on account of its liability to spontaneous ignition.

DRY COLORS AND WATER DAMAGE.

Any dry colors stored in the premises, and especially aniline colors, should be so kept as to cause the least possible damage to other contents of the building in case of fire. In many instances where colors are stored on the upper floors they have been washed down by the water, dyeing the entire building and contents and ruining much stock that might otherwise have been saved.

USE OF BENZINE.

In the cheaper grades of paints benzine is used, and in all cases where it is employed in the manufacture of paints the insurance engineer should be alive to the hazards of the same and use every precaution against the presence of exposed lights or the bringing of matches, cigars or pipes on the premises. In fact, it would be a very wise move to eliminate entirely all smoking from any paint works. The storage and handling of benzine is a problem in itself and should be treated in an entirely separate article, and cannot be discussed in the limited space at our disposal. The liability of the employees' overalls and blouses or other greasy, oily clothing to ignite is frequently overlooked, and owing to the numerous fires that have been directly traced to this cause in paint works they should never be allowed to be kept in the building over night, or if stored in the building they should be so ventilated as to have a draught of fresh air around them all the time, and the room in which they are stored should be of fireproof construction and sprinklered.

CLEANLINESS ESSENTIAL.

It is quite common to find sawdust used as oil absorbents in paint mills. This is a bad feature, as we have tried to show earlier in our article, and should be carefully guarded against. Too much emphasis cannot be placed on the necessity of scrupulous cleanliness in risks of this class and careful disposal of all organic waste that may come in contact with oily matter. The boiler hazards and conditions surrounding the filling and soldering of paint cans require such ajustment as good practice may dictate.

The hazards of grinding dry colors, as well as the manufacture of varnish, properly belong under the general head of this article, but a full discussion of the subject is forbidden by the space at our disposal.

BRICK YARDS.

An Analysis of the Processes of Manufacture, Construction of Buildings, and Hazards of Fire Attendant Upon the Manufacture of Bricks.

By Thomas C. Naulty, Stamp Clerk and Inspector, with the Underwriters' Association of New York State.

The manufacture of brick probably dates from the earliest known times. The Bible mentions the use of brick in the Tower of Babel and the walls of Babylon, while ancient history tells us the Israelites' principal employment as slaves, under their bondage in Egypt after the death of Joseph, was the making of sun dried bricks. The Romans made and used brick, as was proven from the ruins of Rome, and the Romans were the people that introduced the first manufacturing of brick into England after the Roman conquest.

The art of brick making was introduced into this country over 100 years ago from Holland and England.

As a fire retardent brick was not recognized until after the great London fire, after which it was universally adopted for all new buildings erected, and the thickness of the walls was regulated by law.

In the manufacture of brick care should be taken to obtain the following results: (1) Soundness; freedom from cracks and flaws. (2) Hardness; ability to stand pressure and cross strain, and to be unaffected by exposure to the weather: (3) Regularity of shape, so that the mortar that unites the brick together in a wall will be of the same thickness. (4) Uniformity of size, so that all the bricks in a course may be of the same height. (5) Uniformity of color; important only in ornamental work. (6) Facility of cutting, in order that the bricklayer may cut them to any desired shape. (7) Infusibility; important in all brick, but more strictly so in brick used in furnace and boiler work and chimney flues.

PROCESSES.

The process of brick making, the production and treatment of the various ingredients employed should be divided into the following classes:

(1) Preparation of clay or brick earth.

(2) Tempering.
(3) Molding.
(4) Drying.
(5) Burning.

First, preparation of clay or brick earth. Brick yards to be profitable are always located in the immediate vicinity of natural clay banks. The clay found in these natural banks in the Eastern part of this country is composed chiefly of silica and alumina, with smaller parts of oxide of iron, magnesia, water and sometimes lime. If the latter is in the clay to any extent it makes it practically useless for brick making, as, if the action of the lime does not crack the brick in the process of burning it will likely crack when put into use in building construction and exposed to the weather. The clay is dug at the banks mostly with spades by hand, but in some of the larger yards a steam shovel is used. The clay after it is dug is piled into carts and hauled by horse power to the mixing pits. In some of the larger yards, where the clay banks have gradually been dug so far away from the brick yard to make the use of horses and carts too expensive, small railroads are installed, running from clay banks to mixing pits, and are run generally by small steam engines, although in one case electric power is used.

The clay after being drawn and dumped into the mixing pits, which are holes dug in the ground and generally located near the brick machines, is mixed with about 2 per cent. coal dust, 20 per cent. of pit sand and 8 per cent. of broken and old brick, ground into a powder by crushers. The clay itself forms about 70 per cent. of the mixture. To this is added sufficient water to make the brick earth thoroughly plastic.

TEMPERING AND MOLDING.

Second, tempering. The brick earth is then shoveled from the mixing pit into the "pugging" or tempering machine. This is a large cylinder tank with a revolving paddle with knife blades. This paddle constantly revolves, and is usually run by steam power. There is generally a long line of shafting run by one large steam engine, and this shafting will run a half dozen or more pugging and brick molding machines. The action of the pugging machine thoroughly tempers the brick earth and grinds up any foreign substances, such as lime and stone, into fine pieces.

Third, molding. The brick earth after being thoroughly tempered is molded into bricks by molding machines generally run by the same shafting and power as the pugging machines. The molds are always the same uniform size—$8\frac{1}{16}$x$4\frac{3}{16}$x$2\frac{3}{16}$ inches. The molding machines are located adjoining the pugging machines, and so arranged that the brick earth is fed into the machines by gravity. The molds are detachable from machines, and when the brick is formed in the machine by pressure the mold is removed by the molder, who trims the brick evenly on the open top of the mold, and then passes it to a boy, who turns the brick from the mold out upon pallets, and returns the mold to the machine. It is necessary for this boy to sprinkle the inside of the mold with clean, sharp dry sand before it is returned to the machine. This latter is done so that when the brick is molded and removed from the machine it can be turned out without any of the brick earth sticking to the mold.

DRYING,

Fourth, drying. There are two methods of drying after the brick has been molded. The inside or steam drying is used in a few yards, but the greater porportion use the open air or sun drying method. In the steam drying process, after the bricks are molded and turned out on pallets they are put on iron grilled cars, the floor of the car being grilled to allow heat to ascend through the bricks uniformly. The cars are run on tracks into steam heated dry rooms, with the steam pipes located under the rails. By this method a brick yard can be run all the year round independent of weather conditions, and the bricks can be dried in about two hours' time. Steam curing, however, is quite expensive, and is not universally used on that account. The open air or sun drying method prohibits the making of bricks from October to May. In this there are different means employed. First there is the entire open air drying, where the bricks are laid on a plot of ground that has been rolled and hardened. The bricks are spaced about 4 inches apart, four in a row, with a space of about 2 feet between rows. The bricks are turned with their various sides exposed to the sunlight by a boy, who has a clasp that catches the bricks, four at a time. This method of drying is not used to any extent owing to the amount of labor required in case a sudden storm arises. It is necessary to pile the bricks up and cover them with boards, and if this is not done before the bricks become well wetted they will spoil. The second method is similar to the first in regard to laying the bricks out on the ground, but in this there is a large shed covering the entire plot of the drying ground. The roof of the shed is so arranged that it can be opened or closed by levers, and in the case of a storm the whole roof could be closed in a few minutes by a handful of men. The two methods of drying enumerated above are very efficient, and to save space pallet racks are now to a great extent employed. The pallet racks are of wood with a small peaked roof on them, and stand about 6 to 7 feet high and about 2 feet wide. The bricks are put into these racks supported on their edges, with a sufficient air space between. In case of a storm it is only necessary to close the racks on the sides, and this is done by the use of old bags, oilskins or burlap, suspended from the sides of *the racks* and rolled up when not in use. In all three of the last named methods the bricks take from five to eight hours to dry thoroughly, and in inclement weather sometimes a couple of days.

BURNING.

After the bricks are dried they are taken to the kiln sheds to be burned. This is probably the most important part of the process, because if the bricks are not burned in a proper manner the manufacturer stands to lose practically all of the materials and labor involved in the other processes. The kiln sheds are usually about 30 feet high at the ridge of the roof and about 15 feet at the eaves, open at the sides, and the roof generally is not watertight. When the bricks are brought to the kiln sheds they are piled in a large arch forming the kiln, with an air space between, so that the heat from the fire when started under the arch will distribute uniformly as nearly as possible over the entire arch. These arches are built on a dirt floor, and the pits for the fires are dug in the form of trenches before the arch is made. The roof of the kiln shed is not airtight, so as to permit of draughts, and in some yards the roof boards are removable, so that when a kiln is built and a fire started the roof boards can be removed from over the kiln to prevent the roof from catching fire. After the arch or kiln is made of the green bricks there are two layers of old bricks (that have already been in a kiln but not properly burnt) piled all around and on top of the arch, forming a complete enclosure with the green bricks to be burnt inside. After this the fires are started. Some yards use wood and some anthracite coal. The latter saves about a day and a half in the burning. Where wood is used the fire is made directly in the trench under the arch. but where coal is used it is necessary to put an iron grate over the trench and under the arch before the arch is built. The fires are started slowly and are gradually increased in intensity for two days; then all draughts are shut off by covering the entire arch, including the mouth of the kiln, with loam or mud. The fire is then left burning for about four days, when the loam or mud is taken off, the fire having died out in the meantime, and the arch is left to cool. This process takes about a week. The sand used in molds, which has to be dry and sharp, is oftentimes dried alongside of a kiln or arch that is being burned. When the bricks are thoroughly cooled and the arch taken down the bricks that have been in the kiln are found to be either one of the following four classes: (1) "Well burnt," clear, uniform colored brick, which gives a metallic sound when struck. (2) "Outside lights," which have been near the outside of the kiln, and are only good for the outside covering of new kilns or to be crushed up and used with raw material again. (3) "Inside light hards," which are bricks in which the coal dust has fused too quickly and they have not been properly burnt. They are pale and yellowish in color, and the number of them that are found in a kiln depends on how the burning has been managed. They are sold to be used for inside work only, as they will not stand pressure, cross strain or weather; but nevertheless it is common knowledge of the brick yards along the Hudson River that these bricks are shipped to dealers in New York, particularly Brooklyn, and the dealers mix them in with other well burnt bricks and sell the mixed bricks as well burnt bricks to builders and contractors to be used in building construction. This should not be taken to be the fault of the manufacturer, who always sells this class of bricks with the understanding of what they are and always gets a very low price for that reason. (4) "Lammies" are bricks that have been burnt too much and have "bulged" and lost their regularity of shape These bricks are otherwise perfectly good and sound, but owing to irregularity they are unsuitable for building purposes, and are sold to be used mostly for sidewalks or cistern lining.

CONSTRUCTION OF BUILDINGS.

The construction of the various buildings used in brick making is generally light and usually very poor. The buildings are very seldom painted. The drying and kiln sheds are mostly of one story, open sides and peaked roof construction. The boiler and engine houses are generally of frame construction, seldom over one story high, with either shingle, metal or composition roof coverings. A few of the yards have substantial, unexposed brick boiler and engine houses, but these are the exceptions to the rule. The drying sheds, under which the "pugging" and "molding" machines are usually located, are always of frame construction. They are of considerable area, and in most cases are exposed by the engine and boiler house and kiln sheds. The "brick crushers" are sometimes run by general shafting and power, but generally they are run by their own steam boiler and engine.

HAZARDS.

The physical hazards are principally the usual hazards of the boiler and engine room, and the aligning and lubrication of shafting and bearings, especially where one steam engine will run ten to twenty machines by a general line of shafting extending over a considerable area. The hazard of the dry kilns is very great at times, owing to carelessness in handling the fires and the likelihood of the roof over the kiln catching fire. I believe that the majority of brick yard fires are from this cause. The "brick crushing" machines are generally either out in the open or in small individual buildings of such small area that a fire occurring in one of them probably would not affect any of the other buildings. Another hazard is the poor construction of boiler and engine houses and the sheds. These are nearly always unpainted, and the action of the sun for years on this wood makes it as inflammable as tinder.

The moral hazards of brick yards is often considered of greater importance than the physical hazard. It would always be well to note the extent of the clay deposits in the immediate vicinity of the yard, and if the same is near exhaustion the plant is practically worthless. A very low class of labor is employed, mostly Italians, who live in tenements on brick yard property, and as most of the yards are isolated from police protection there is always a moral hazard involved in the many labor disputes that arise. Another feature is that the fierce competition in the brick yard business and the lack of any price or trade agreement among the manufacturers has driven the price of brick down practically to the cost of production, and the business is so financially hazardous itself that this feature presents a certain moral hazard.

FIRE PROTECTION.

Practically none of the yards along the Hudson River are near public fire protection, and there are only one or two that have any organized protection of their own. Most of them are located on the river front, and obtain their water through pumping from the river, and most of the yards have a certain amount of fire hose to be used with these pumps. The majority of the plants protect their boiler and engine houses with the usual fire pail or extinguisher protection, but pay little or no attention to the rest of the property. The proper protection that should be installed in all yards is an outside system of two-way fire hydrants on at least a 4 inch water main connected either with a gravity-fed inexhaustible supply or with a direct pumping system from a river or pond of sufficient size. The fire pump should be located in a detached brick building or in a fireproof room in the boiler house. The pump should be of at least 1,000 gallons capacity. Steam should be kept up day and night all the year around. There should be sufficient fire hydrants to properly protect all buildings and sheds on grounds, and sufficient quantity of standard rubber lined linen fire hose of at least 2½ inches in diameter, with nozzle attachment. Hose should be kept reeled in a small hose house containing nothing else and situated where it could be conveniently reached in case of need. Racks should be provided so hose can be dried after using. A watchman should be employed at night when yard is in operation, and continually during the inoperative months.

PATENT AND ENAMELED LEATHER RISKS.

The Hazards of the Industry, With an Account of the Tanning Processes Involved and Suggestions for Maintaining This Class of Business.

By Harold G. Howe, Inspector with the Commercial Union Assurance Company, Ltd.

The patent and enameled leather industries of this country, and we must not forget that patent leather was first made in America, are to be found principally in the cities of Newark, N. J., and Woburn, Mass. As a general thing these manufactories are sole tenant risks, and are located in the outskirts of the city, where room is not limited and they can spread out. Their construction and composition may be anything from lightly constructed frame to sprinklered, fireproof construction, and let it be known there are very few of the latter.

The average patent leather risk presents a mixed and motley collection of buildings, constructed and added to with no view to stopping a fire if it once secures a start. In most cases it is a growth—the result of a very small beginning.

What might be called a full process, or a fully equipped plant—and such a risk is found frequently—has connected with it a tannery, where the concern manufactures its own leather from the hides. As the tannery is quite a separate subject, and should preferably be treated as such, this paper will deal mainly with the process, manufacture and incidental fire hazards to be met with in the making of patent and enameled leather, and so give but a brief synopsis of the tanning processes.

THE TANNERY.

The hide, whether it be green or dry, is first soaked in cold water and then placed in the lime pit or vat in a solution of lime, to which is sometimes added sulphur. This operation loosens the hair and swells the hide. After about a week's time the hides are removed from the liming bath and the hair scraped off, either by hand or by a special machine. This hair is frequently dried on the premises—various kinds of dryers being used—baled and sold to the carpet trade.

The hide is next "beamed" for the removal of the superfluous fat and ends, after which it is "bated," viz., an operation to neutralize any remaining lime.

The hide is now ready for tanning. It remains in the tanning bath, which is a solution of extract of tannin obtained by "leaching" oak, hemlock and other barks. Gambier, a leaf extract, is sometimes used, while for tanning sheep skin sumach is employed. The hide is kept in the tanning solution anywhere from sixty days to two years, according to the grade or nature of the hide. Under a new secret process leather is being tanned in ten days. This new method is said to include neither lime nor chrome in the process, and will possibly revolutionize the leather industry. Alum is sometimes used, together with other chemicals, as a substitute for lime or chrome, and it is a combination of some of these, it is believed, that is being used in the new process.

The tannin and moisture is next pressed from the hide, which is followed by splitting. A band knife splitter, the blade of which is kept sharpened by two emery wheels attached to the machine, is used, the hide being split when damp in from two to three thicknesses. The grain, the one next to the hair, being the choicest, is used for the finer grade of work. The other cuts are termed splits.

This operation is succeeded by another washing and scouring, and sometimes by a brief retanning to obtain the proper color. It then undergoes what is called "setting out," an operation to remove all liquor and to "stretch" the hide.

Hides are next dried, either by steam (temperature about 70° Fahr.) or by air, "slicker" buffed, "skived" or "shaved," and then softened by doubling, rolling and working with an armboard. Finally all holes are patched, glue being used and thin scrap leather for this purpose. This is termed pin blocking. The leather is now ready for the making of patent leather.

THE FIRE HAZARD.

The fire hazards of a patent leather factory are to be found chiefly in connection with the "boiling" house, wherein is found the following: the boiling of linseed oil over an open fire, the reducing of oil with naphtha, the mixing of the lampblack, and the preparation of the daub; and secondly, the japannery, where the leather is coated and dried in ovens, and likewise is found naphtha, amylacetate, guncotton and celluloid in solution, the mixing of paints and other processes less hazardous, as more fully described later on.

THE PROCESS.

The manufacture of patent and enameled leather consists in applying to the leather or finished hide, whether it be goat skin, sheep skin, horse, calf or beef hides, several coatings of daub, composed of boiled linseed oil as a basis and lampblack or some other pigment.

This composition has been previously reduced by the use of naphtha, which, being a volatile, makes this process, known as "daubing," exceedingly hazardous. The number of coatings the hide receives depends upon the grade or use to which it is to be put. Some skins receive as low as four coats. These are chiefly leathers for the shoe and handbag trade. Others receive as high as twenty coatings, which produce a heavy patent leather for the automobile, carriage and harness trade.

Of the lime and chrome tanned leather the latter is considered to make the best patent leather, as it is tougher and wears better.

The manufacture of enamel leather is similar to that of patent leather, except that instead of the smooth, glossy finish it presents a pebbled or corrugated surface. This finish, termed "graining," is caused by rolling the coated leather when dry face side in and working with an armboard or paddle—an operation resembling softening. The "pebbling" is done by a special machine, the coated leather being passed over a raised steel die. Enameled leather does not require any less coating than the lighter grades of patent leather. Neither of these operations involves any hazards.

BOILING HOUSE.

The boiling house where the daub is prepared is usually a brick building of superior construction, one story high, and is supposed to be located at a safe distance from the main plant. In some cases there are as many as six boiling kettles, and then again only one, according to the size and needs of the factory.

Coal and coke fires, and infrequently steam heat, are used. The interior of the building is hard finish, with a brick, concrete or dirt floor and an iron door at the entrance. There is a large brick flue or vent at the end similar to a varnish flue in appearance. The linseed oil is poured into the iron kettle, which is fastened to a small car, and run into the boiling house on a track to the pit containing the fire.

The oil is boiled to a temperature of between 500° and 600° Fahr. Great care should be taken to see that it does not boil over. New oil is known to boil and froth more readily than old or aged oil. The naphtha and lampblack, or pigment, is not added until the vessel has been withdrawn from the building and the temperature reduced to about 105° Fahr.

This operation, termed "reducing," constitutes the greatest danger in connection with the manufacture of patent leather, and has been the cost of many lives as well as the cause of numerous fires and explosions. The daub—for such it is—is now thoroughly mixed, and a jelly-like substance, is ready to be applied to the leather, and is taken to the japannery in open buckets and used from same.

BOILING HOUSE HAZARDS.

The storage and handling of naphtha as well as the location of the boiling house are important factors in the safety of a risk. Where turpentine is used as a substitute for naphtha for reducing, as in a few cases, the hazard is considerably minimized. But, for the fact that turpentine does not give as good results as naphtha, it is not extensively used.

Naphtha should be stored in a steel tank underground and away, 25 feet or more, from the boiling house of any other building. Naphtha should not be left standing on the premises in barrels, and should be pumped from the tank and carried to boiling vessels in covered buckets. The greatest care should be exercised in its handling.

Lampblack, which has the property of igniting spontaneously, especially if it becomes wet or damp, should be stored in a separate building, preferably in a safely detached dry building, together with the raw linseed oil, which is received by the several barrels and is to be found generally near the boiling house, in the open yard, or a small building adjacent thereto. Boiling kettles should have vented metal covers to allow for the escape of the gases arising from the oil and as a safeguard against boiling over and igniting. Linseed oil before the boiling point is reached liberates at 300° to 600° Fahr. explosive and spontaneously ignited vapors. It easily boils over, especially when impure.

The rise in temperature is very irregular and difficult to control with an open fire. It often jumps up suddenly, particularly at higher degrees, whereupon dangerous overflowing readily ensues. At times the oil or added material readily burns onto the walls of the pan, bakes hard and helps the pan bottom to grow hot, thereby easily leading to an explosion.

The boiling house and the preparation of the daub should be in competent hands, as the boiling of the linseed oil requires constant care and attention and due diligence to the hazards involved. The boiling house and its contents should not be, and as a rule are not, insured.

THE JAPANNERY.

The japannery or daub coating building may be brick or only frame construction, one story in height, or, as in some cases, as high as five stories. The more modern patent leather factories have constructed their japanneries with a view to safeguarding them and the balance of the plant. Fireproof construction is to be met with occasionally in this section of the risk. There are still, however, many of the oil type japanneries of brick and frame construction, and it is to this latter class chiefly that the patent leather japanneries risk owes its bad loss record.

The daub room, whether it be of fireproof construction or not, or whether its walls be hard finish or frame, with open joisted ceilings and wood or concrete floors, contains several japan ovens, varying from four to six, according to size of the risk and the number of japan houses, some plants having several, all adjoining but not always communicating, each section being divided by a good fire wall, which is parapeted and so forms a separate and distinct risk. These sections have been known to hold a fire.

The leather, all prepared as previously described, is brought to the daub room, tacked and stretched on wood frames, and laid flat on wood horses. A prime or filler coat of daub is then put on, which is well rubbed in and the leather is next run into the ovens to dry.

These ovens are in all cases steam heated to a degree of between 125° and 150° Fahr., never higher. They are the height of the room, generally about 12x12 feet deep, and are sometimes made of steel, but most often are of wood, tin lined and containing steam coils arranged within a few inches of the floor. Over these coils are usually laid a wood floor, upon which the frames are stood on end. These ovens are sometimes vented to the outside of the building, which is a very good feature.

The priming coat, after being dried, is followed by other coatings, according to the needs of the leather, the daub being applied with a stiff hand brush and later scraped and smoothed with a steel blade resembling somewhat an old fashioned meat chopper, which is termed a "slicker."

After each coating as well as after a coat or two of japan or japan varnish—the finishing coat—the surface is well rubbed with pumice stone (termed "stoning") and water, which hardens and smooths the various applications.

In cases where patent leather factories have the facilities for sun drying this method is resorted to, the leather being set out between coatings. This drying tends to oxidize the oil in the daub and to harden the surface.

On an extremely hot day the sun has been known to set fire to this stock. Colored patent leather is made by adding the pigment to the finishing coat, when a special varnish made from copal gum is used. After the final drying the leathers are taken from the frames, trimmed, measured and stored. Patent leather to be good should be left to stand for a time to properly season, and great care must be exercised to see that it does not become scratched in the handling.

JAPANNERY HAZARDS.

In the few cases where turpentine is used as a substitute for naphtha the chief source of danger has been removed, but as the great majority of patent leather factories still use naphtha for reducing the daub to a consistency suitable for the coating of the leather, we are confronted with this dangerous volatile.

In the daub rooms will be found several pails of the "sweet meat" as the daub is often called, containing naphtha, linseed oil and lampblack, as well sometimes an occasional pail or two of pure naphtha standing around to be used for further reducing the daub or cleaning. The mixing of the varnish and the paints that form the colors that produce the colored leathers are likewise to be found here.

An extremely hazardous finishing coat or patent leather black paint is frequently found, said paint being made of guncotton and scrap celluloid in solution with amylacetate and wood alcohol. Its flash point is below the ordinary temperature, 45° Fahr. The coating of the leather is done by hand, two men employed generally to a hide, using a steel "slicker" or "spreader," the daub being dipped from the open pails on the floor. Static electricity, caused by the striking together of these instruments, a nail or some metallic foreign substance in the daub, has been the cause of innumerable fires in japanneries.

Two fires occurred only recently at Newark, N. J., and within twenty-four hours, from this cause. On very dry, oppressive days, when the naphtha fumes fail to rise to any considerable height, this danger is most to be feared, and numerous small fires are put out by smothering them with another hide.

Another fire is known to have been caused by the blow of a pick, to release a door that would not close. This generated a spark, and ignited naphtha fumes on the oil caked floor.

The presence of artificial lights in a japannery is extremely dangerous. Incandescent electric lights should be used, and only lamps of the keyless socket variety. Great care should be exercised to see that no switches, fuses or cutouts of any nature are within the building, and that the electric wiring is well insulated.

The arrangement of the ovens should be carefully investigated. First, care should be taken to see they are kept clean, and that the steam pipes are not in contact with the woodwork. Ovens should be well ventilated, preferably to the outside of building. A $15,000 fire in New Jersey recently in a japannery was caused by steam pipes.

With the presence of linseed oil, and its property of igniting spontaneously, one must discourage the careless disposition of waste, etc., in this section of a plant, and should insist upon the best maintenance and care of so much combined hazard. It should always be borne in mind that for a danger point the patent leather japannery has but few superiors and but a small number of equals.

TO SUMMARIZE.

The boiling house and japannery should then be separate buildings of fireproof construction. The japannery, being strictly fire resisting, should be thoroughly sprinklered, even to the interior of the ovens, as a protection for the stock, for until such time as the number of fires in japanneries is considerably reduced there will be no underwriting profits from this class of risk.

CANDY MANUFACTURE.

A Review of the Processes and Incidental Hazards Involved in the Manufacture of Candy—The Moral Hazard Light.

By J. D. Waite, Inspector, 58 William Street, New York City

With the present facilities for erecting buildings of superior fire resisting qualities, to which may be added the element of sprinkler control, there is no reason why the candy factory cannot be made as safe a risk as some of the other so called special hazards.

MODERN IMPROVEMENTS.

In the larger establishments, supplying the trade, or, if their business warrants, direct to the public through their own stores or agencies, the modern factory embraces every process, not alone one particular kind or style of candy, but every sweetmeat ever thought of, from "4 for 1c." gumdrops to the dollar a pound bonbons.

As in everything else, the manufacture of candy progresses with the times, so that in establishments which years ago were boiling their syrups over open coal fires you will now find the boiling process carried on in steam heated vacuum pans, a scientific application of a principle which might long ago have been adopted. The advent of modern ideas, however, and the ardent desire of the manufacturers to condense under one roof as many processes as possible (especially true in large cities, where the trend of building construction is upward), has brought about a condition where one finds light and heavy hazards in close proximity.

GRINDING CHOCOLATE.

Just what makes chocolate as a flavor the most popular in demand is a question only to be answered by those who consume it; assuming the riddle solved, however, the result is that the demand must be met with a supply. Hence, in the order of present day business methods, the larger producers of chocolate candy grind their own cocoa, from which the chocolate is made. In itself the hazard of chocolate (cocoa) grinding is not serious, except as the use of any elaborate machinery is hazardous. The various grades of cocoa beans are run through large stone rollers, crushing the bean into a liquid pulp, which is in turn diverted into large cylindrical mixing pans and thoroughly ground, producing in time a fine syrup, which may be coarse or fine, according to the length of treatment.

ROASTING OVENS.

Incidental with chocolate's popularity, nut centres continue in demand, which, as in the case of the former, the manufacturers meet with a supply according to their ability. This brings us to what is, perhaps, as large a hazard, if not watched, as any—nut roasting. As yet steam is impracticable for roasting purposes. The best results are obtained over a dry coal fire. Roasting ovens should be properly grated, and rest upon a firebrick base. The chaff is seldom removed before roasting, and fires sometimes start from this cause. Nut centred candies are made by rolling the nuts in a cylindrical copper kettle having an inclined axis. As the kettle revolves syrup is poured in and is caught up by the nuts in tumbling about.

COATING.

Cream candy, also, forms a very large proportion of the bonbon trade. As in the case of chocolate, the vacuum pans are used to boil down the sugar and glucose. When sufficiently boiled the batch is set aside, sometimes for days, to settle. Then it is put into large mixers, to work it out and grain it to the finest consistency possible. When worked to a smoothness of velvet, it is ready for the coating, which is done by hand, although in recent years machines have been perfected which dip the candies as perfectly as can be done by hand. At the dipping tables the chocolate is kept in pans, which are warmed by steam. The hazard is again reduced to the usual steam pipe hazard, if that is used. In some establishments gas heat is still used, the open flames being enclosed in metallic shields.

DRYING.

The bonbon now has a creamy centre, with a coating of chocolate or cream "frosting." It is placed on a tray constructed of wire netting, the mesh being about one-quarter to one-half inch, the size of the tray varying from 12 to 18 inches by 24 to 30 inches. When filled the tray is placed upon an endless belt which moves slowly through a heated room of high temperature, then out again, and into another room of low temperature. The candy is then allowed to stand for a few days before it is packed.

STARCHING.

The additional processes and hazards over the boiling and mixing is the starching. Powdered corn starch is packed on oblong trays, the depth of the packed starch being about 2 inches. A plaster-of-paris mold, having inverted cup shaped impressions, is pressed into the starch, making a series of impressions, into which warm syrup is fed from a hopper in the starch buck. The starch molds are passed through the buck on an endless belt, the hopper feeding it with the syrup. When the mold reaches the end of the belt it is removed by hand, and, still intact, placed in tiers or stacks in starch dry rooms. When the candy is sufficiently cooled and dried out, it is again run through the buck, and a hopper throws off all of the starch, which, falling through a sieve, is reclaimed, the candy forms being sent to other processes. Cream centres for chocolates, licorice and gum drops are some of the various candies treated in this way. The bulk of the starch being shaken off as the candy leaves the machine, a fine dust is constantly in the air, and the hazard is in the resultant explosion, which, given the proper conditions, is most likely to occur. Wherever possible starching should be done in the open air to reduce this hazard to a minimum. Drying of the starched candy should also be done outside, and where this is impracticable, inside drying in a fireproof room is permissible and considerably more desirable than a dry room of ordinary construction. In recent years, the use of starch for drying and molding has been improved upon by means of an entirely new method.. Para rubber forms are used, the forms coming in convenient sizes, and having the same cup-like depressions as in the starch mold. The candy is fed through a hopper in the buck to the rubber mold. When dry the candy is ejected from the mold by bending the latter. While the dust hazard is eliminated entirely in this method, it is doubtful if it can be brought into general use owing to the difference in cost.

FINISHING.

In the cheaper grades of chocolate, made up in fancy forms, shellac is sprayed over the forms to brighten them up. Generally but a small amount of alcohol is used in the shellac, but obviously open lights should not be used.

INCIDENTAL HAZARDS.

The candy, boiled, mixed, rolled, cooled and polished, is now ready for packing. The finer grades are boxed from one-half to five pounds to the box. The cheaper or bulk candy is packed in pails and cartons of from ten to fifty pounds. It is seldom if ever the case now that wood and pasteboard boxes are made under the same roof with the candy, but in outlying districts one may find their making a part of the plant, large enough to occupy several buildings and a large area of ground. The cooling rooms are generally made so by an independent system of cold storage apparatus, and the usual hazards incidental to cooling systems are to be found.

With candy packed and shipped, we may leave the factory and look, figuratively speaking, into the office. There is no physical hazard here, and doubtless not a large moral one. The United States census for 1905 (the latest obtainable) reports that in all the country there are 1,348 establishments engaged in the manufacture of confectionery, having an invested capital of $43,125,408, and giving employment to 36,000 people. The cost of the materials used amounted to $49,000,000, and the resultant value of the product amounted to $87,000,000. With such an enormous amount at risk, invested solely in providing a luxury which could well be dispensed with, the moral hazard should be looked into rather carefully, but, fortunately, the popular demand for the product, and the well known "sweet-tooth" of the American people, give promise that, when sanely managed, the average candy factory has a much stronger lease on life than some of its less fortunate neighbors producing the actual necessities of life.

THE TOBACCO INDUSTRY.

An Exposition of the Processes of Growing and Curing Tobacco—The Fire Hazards of Tobacco Warehouses and Drying Machines.

By I. G. Hoagland, with the South Eastern Underwriters' Association, Atlanta, Ga.

Underwriting considerations of the tobacco industry cannot well be limited to the question of fire hazard solely, there being so many diversified features, all of which have bearing on usual underwriting propositions.

To more than briefly outline the subject is not quite possible in a brief article, but the writer's endeavor is to cover comprehensively the following subject matter:

Classification and description of various domestic types of tobacco of commerce.
Methods of harvesting and curing.
Description of curing barns.
Marketing tobacco.
Rehandling and stemming.
Manufacturing tobacco.
Tobacco warehouses.
Tobacco drying machines.
Special and common hazards.
Miscellaneous considerations.

If at any point in this paper it is noted that the writer's point of view differs from current practice in certain matters it should be understood that this is a personal contribution and not officially sanctioned because of the writer's present position.

CLASSIFICATION.

Tobacco is classified according to purpose of use (class), general qualities of leaf (type), and degree of excellence of leaf (grade). To illustrate: cigar leaf (class), Sumatra wrapper leaf (type), dark good leaf (grade).

CIGAR TOBACCO.

For the complete cigar three distinct types of tobacco are necessary. Leaves of finest quality and texture are used for wrappers, those of inferior quality for binders, and the darker, stronger and heavier leaves for fillers.

Domestic wrapper tobacco is grown chiefly in northwestern Florida, southwestern Georgia and in the Connecticut River Valley; also to some extent in New York State, Pennsylvania and Wisconsin.

Filler leaves are especially grown in Pennsylvania and Ohio and in Florida.

Three varieties of wrapper leaf are now grown in the Connecticut Valley. For years the Broad and the Havana seed leaf were the only types. Recently the Department of Agriculture introduced the Sumatra leaf from Florida grown seed.

All cigar tobaccos are air cured.

MANUFACTURING TOBACCO.

So called manufacturing types are often confounded with export types, as both varieties are often grown in the same section and used for both purposes.

In general they are the mahogany, red, brown and other colored types of Virginia, Maryland, Ohio, the Carolinas, Tennessee, Kentucky and Missouri.

The light tobacco of Maryland is air cured and similar types in Ohio are cured with wood fires; mahogany types are flue cured generally, and also other types in this manner and by the sun.

This class of tobacco is used generally for fine cut pipe smoking and chewing and cigarettes, and for plug and twist wrappers and fillers.

YELLOW OR BRIGHT TOBACCO.

This type is grown mainly in the Piedmont region of Virginia and the Carolinas, and some in eastern Tennessee. It is being introduced into other States. This tobacco is grown in sandy, sterile soil, and cures a lemon yellow color. It is mild and sweet flavored, and is used for plug, wrappers and fillers, for cigarette, fine cut and low grades—lugs and cutters—for granulated pipe smoking.

All of this type is flue cured.

WHITE BURLEY TOBACCO.

Cultivation of this variety is confined to the "blue grass region of Kentucky and Ohio. It has a mild flavor, low nicotine content and great absorbing capacity for flavoring sauces, which make it especially valuable for domestic sweet chewing plug. Light grades containing but little oil and gum are used for fine cut smoking and low grades—flyings and trash—for granulated smoking.

Curing is by air, except in cold, damp weather, when heat from open wood fires, stoves or lamps is used to prevent excessive atmospheric moisture in the curing barn.

EXPORT TOBACCO.

Types of this class, variously termed dark export, heavy shipping, etc., are grown in heavy, fertile soils, chiefly in western Kentucky and Tennessee, to a less extent in Virginia and North Carolina, and in other tobacco States.

Generally the leaf is large, fat, tough and elastic, and has a large content of nicotine and creosote, which is especially desired abroad. Curing is done altogether with open, slow burning, hardwood fires, the smoke having a preservative effect on the leaf and giving it a smoky flavor.

Of all tobacco exported Great Britain takes the most and best, paying the highest prices. The so called "Regie" countries, where the governments monopolize the tobacco trade, take the inferior grades.

HARVESTING TOBACCO.

Though tobacco is a perennial plant, it has to be grown each year from seed. The seed is planted in a specially prepared seed bed, and when the plants have attained sufficient growth they are transplanted or "set out" in the field.

There are several methods of harvesting. The oldest and most general method is to cut the whole plant when there is an average condition of ripeness. This prevails in the Northern cigar leaf, manufacturing and export districts. A later and more desirable method is to "prime" (cut or strip) the leaves from the stalk as they ripen.

The period of harvesting varies with the section in which the tobacco is grown. In Florida "priming" the Sumatran leaf is continuous from June to September. The Cuban leaf is harvested both by cutting the whole plant and by cutting the stalk in sections; also by "priming." If plants are cut they are "speared" on poles or laths and hung in curing barns. If "primed," the leaves are gathered up in baskets and strung on poles in the barns.

Harvesting bright yellow tobacco begins late in July in the southern portion of the Piedmont section, and later farther north. The "priming" method has largely displaced that of cutting the plant.

White burley tobacco harvest begins in August. Stalks are first split down, then cut, the plants allowed to lay a while on the ground to wilt; then they are straddled over sticks supported on a scaffold in the field. In this way the plants are allowed to wilt a week or so before being hung in the curing barn.

Export tobacco is harvested early in September, quite in the same manner as is white burley.

CURING TOBACCO.

The object of curing tobacco is not more to dry out excess water in the leaf than it is to obtain a desired color, fix it and arrest the escape of juices. This is termed "killing the leaf." Curing processes vary with the kind of leaf and the use for which it is intended.

To properly develop the flavor and aroma in the leaf tobacco undergoes a period of fermentation after curing, which will be described later on.

There are two general ways of curing tobacco, one natural, the other artificial. Natural methods make use of air or sun and artificial methods the heat from closed or open fires.

Until 1828 wood fires were the only artificial means used in curing. About that time charcoal fires and flue heating began to be used, but not until 1865 did flue heating become universal.

Sun curing is done on scaffolds in the field; air curing is accomplished under cover in tight barns, specially designed nowadays.

Cigar tobaccos are air cured exclusively, except in Ohio and Wisconsin, where small stoves or lighted lamps are often used to dry the air in the barns in wet weather. In curing Connecticut Valley Sumatra leaf it is often necessary to do likewise, and small open fires of wood and charcoal are used. White barley is generally air cured exclusively, except in rare cases, when wood or charcoal fires are built in damp weather.

Two methods are in vogue of using artificial heat. The most notable examples are by building open fires of hardwood on or in the barn floor, as is the custom in the export tobacco country, and by radiation of heat from flues heated by furnace fires, as is the practice in the bright yellow tobacco districts. Curing of export tobacco takes about five days. Fires are built small at first and temperatures started at 90° Fahr. The fires are increased in size until a temperature of 150° Fahr. is attained. Well seasoned hardwood is generally used. Bright tobacco takes about four days. The barns, purposely small, are quickly filled after harvesting, and the firing begun. Temperature is started at 90° Fahr. and gradually raised to 180° Fahr., the maximum. Air curing of cigar leaf takes several months, and of white burley about six weeks.

TOBACCO CURING BARNS.

Curing barns are variously modified in construction and arrangement to fit methods in vogue in various sections. Thirty years ago most any sort of building was used. Not so is it today. Wood is the universal building material. Two general types of barn are in use, the framed barn and the log barn. The former is built of a wooden frame sheathed with wood, generally one story high, with gable roof, and some have basements. Areas are often large and the shape is generally rectangular. Inside is arranged a stout framework of timbers, which supports the poles or sticks of tobacco. Schemes for ventilation are numerous. The prevailing method is to hinge a number of sections of side walls to be opened and shut by hand. This type of curing barn is usual in the Connecticut Valley, eastern Pennsylvania and the Central States.

Framed barns in the export districts are tightly built without ventilating openings. They range from 26 to 48 feet square. Many barns are so built that the lowest tier pole upon which the sticks of tobacco are hung is 3 feet above ground. Holes for fires are then dug some 7 or 8 feet deep. This effects a better arrangement for the fires than that on a flat floor, where there are draught disturbances, and permits of better regulation of the fires. In barns with flat floors the lowest tier pole is 8 feet above the floor. Fires are built between two logs laid parallel a short distance apart. Fires have to be carefully tended lest they become general.

Log barns are essentially the pioneer type. Old style barns were merely cribs of logs roofed over. Early flue barns were built of round logs, the interstices daubed with mud. Today hewn logs are generally used. Sizes vary from 17 to 24 feet square, and additional capacity obtained by adding "lean-to" sheds, 12 to 15 feet wide, on one or more sides of the barn.

In that there are many modifications of flue barns, it will suffice in this paper to describe an ordinary and a patented barn, as used in the bright tobacco section.

Ordinary barns are generally built of hewn logs, with interstices "pointed up" with lime mortar or mud. An average size is 17 feet square and 17 feet high, with hipped roof. For supporting sticks or poles of tobacco a barn of this size would have four sets, or rooms, of tier poles, four high. The lowest would be 8 or 9 feet above grade.

Often several dozen of such barns are on a single plantation. The limited size is necessary for proper curing, and as the barns often burn the loss is small.

The heating equipment consists of two furnaces of brick arch construction—perhaps—built in one end of the barn. The flues from these extend to the opposite wall and return and pass through the furnace wall of the barn and vent outside.

In some old barns flues direct from furnaces are in the form of trenches dug in the floor and covered with sheet metal; return flues are of sheet metal pipe.

In modern barns flues are all of metal, and if a brick chimney is not used the flues are often joined together and vented through one smoke pipe.

A typical patented flue barn is the Snow barn. Many advantages of a technical nature are claimed for this barn; also that less fuel is required, and that there is less hazard from fire. An average size is 16x20 feet. Construction, timber frame, sheathed *with wood* outside and in; roof, hipped, shingle cover; height, two stories, first for furnaces and flues and second for hanging leaf. Furnaces and flues are arranged much the same as they are in ordinary barns. A slotted floor is built about 7 feet above the furnace floor. Above this are tiers of rectangular frames arranged to work up and down in grooves; these carry the sticks of tobacco.

A system of flue heating to control wet weather conditions in the Ohio and Wisconsin cigar leaf regions has been suggested to take the place of lamps and stoves. Barns in these sections are often very large, and it would be necessary to install a large number of furnaces; such an arrangement would be temporary, the idea being to remove the stoves and flues after curing.

The handling after curing varies widely in different growing sections. In Northern cigar leaf districts the first damp day after curing the tobacco is taken or "struck" down, piled in heaps and covered with cloths to keep the "order"—moisture the leaf absorbs from damp atmosphere—until time for stripping.

As stripped the leaf is assorted and graded, made up into bundles, or "hands," and packed into cases. This "casing" is done in wooden cases holding from 300 to 350 pounds of tobacco.

HAZARDS OF TOBACCO BARNS.

The first hazardous condition met with on the journey of the leaf from field to consumer is in the curing barn, or, as it is also termed, the farmer's barn, where artificial heat, intermittent or continuous, is used in curing.

Tobacco barns may be classified as follows, according to excellence as insurance risks:

1. (*a*) Air curing barns, no heat, no stripping; (*b*) air curing barns, no heat, with stripping.
2. (*a*) Air curing barns, intermittent heat, no stripping; (*b*) air curing barns, intermittent heat, with stripping.
3. (*a*) Heated curing barns, continuous heat from flues, no stripping; (*b*) heated curing barns, continuous heat from flues, with stripping.
4. (*a*) Heated curing barns, continuous heat from open fires, no stripping; (*b*) heated curing barns, continuous heat from open fires, with stripping.

The addition of stripping operations in a curing barn contributes much to the chances of fire. Stripping being done chiefly during cold weather, it is necessary to provide heat for the hands, and besides often defective installation of stoves stalks are carelessly thrown about even on the stoves. The stalks are rich in potassium nitrate, which causes them to burn readily; also to smoulder for a long time when once ignited.

Before curing, while the leaf is green and moist, it will not burn freely, but becomes increasingly combustible as curing progresses. After curing it is quite as inflammable as hay.

Aside from the fact of additional hazard, stripping room occupancy means that so much more of value is subject to one fire—"too many eggs in one basket" as it were. Some years ago a Connecticut barn in which stripping was done burned; loss several hundred thousand dollars.

Barns classed No. 1 are usual in the cigar leaf districts of Pennsylvania and Connecticut; stripping rooms, if any, are generally in the basement; stoves are used for heat, and gas, electricity or oil for lights.

Barns classed No. 2 are usual in the cigar leaf districts of the Central States, where intermittent heating is often necessary in wet weather. This is had from stoves, large and small; from lighted lamps, and sometimes from small open fires of wood and charcoal. The introduction of flue heating has been talked of.

The intermittent use of heat where such heat is more the exception than the rule is often marked by carelessness and indifference in properly arranging and safeguarding heating apparatus. In experimenting with Sumatra seed leaf in Connecticut the Government experts resorted to intermittent heating on bad days in their barns. It burned. Too much care cannot be exercised in establishing heating apparatus. It should be permanently established in conformity with the best practice, and not carelessly set up and dismantled after use, which is largely the custom.

Continuously heated flue barns, classed No. 3, are found in the bright yellow districts of North Carolina and Virginia. The patented barn is to be preferred to the ordinary barn. Furnaces and flues cannot be too carefully installed. The flues often get red hot, and should have ample clearance from walls and the hanging leaf. With well built furnaces and flues, and with flues venting into brick chimneys, these barns might be recognized as insurable property, but the average barn is quite impossible.

Another hazard in flue barns is in the practice of casting wet straw on the flues after curing to humidify the air so the leaf will soon be brought to good "order" for "striking."

Barns continuously heated by open fires, classed No. 4, are to be found in the dark export region of Kentucky and Tennessee. The best arrangement of fires is, of course, in pits dug in the floor, where there is no disturbance from draughts, as is the case when fires are built on flat floors, causing them to blaze up. Also the pit fires can be quite closely regulated. The fires are generally of hardwood, which burns slowly, with very little smoke.

The space between the bottom of the leaf and the fire is generally not more than 6 feet, and may be less. The fires need constant care, as when they blaze up the tobacco is set afire. Many cases have been recorded, especially about Hopkinsville, Ky., where barns and contents have totally burned because of carelessness in firing. This method is peculiarly necessary, and cannot be replaced by any other.

FIRE RECORD.

Of sixty-four barn fires recorded in five years (1897-1901) 34 per cent. were in open fired barns—one-half of these about Hopkinsville, Ky.—and 23 per cent. were in air barns in Connecticut, the balance scattering, but principally in Massachusetts, Wisconsin and Tennessee. The chief causes of the air barn fires were unsafe stoves and their flues in stripping rooms, incendiarism and lightning.

BREWERIES.

A Review of the Hazards of Malting and Other Processes to Be Found in Ale and Beer Breweries—Recommendations for Fire Protection and Prevention.

By John M. Boylan, Inspector, with J. Lehrenkraus's Sons, Brooklyn, N. Y.

Risks of this class consists of a group of buildings, the number of which varies from two to twelve or more, being determined by the size or progressiveness of the concern. Rarely, if ever, is a brewery confined to one building. The plant is usually located in a section where ample ground may be had and the favorite arrangement of buildings is in form of a quadrangle with an open court in the centre.

CONSTRUCTION.

While not always of the best, breweries in the metropolitan district will as a rule be found of good heavy construction, particularly as to the important buildings; although even in this territory some plants are still to be found where all buildings, irrespective of their importance, are of poor construction. It is an encouraging sign, however, that those concerns whose progress requires erection of new buildings are favoring superior construction, and while in some cases this results in a plant having buildings of a construction varied from the poorest to the best, it is certainly a sign of advancement.

Usually the various buildings will be found to communicate; in some cases the openings will be found so numerous or so poorly provided with fire cuts as to make the entire plant practically one risk. While good, double, standard automatic fire doors at the openings are the next best thing to an uncut wall, too much faith should not be intrusted to them in plants of this nature, particularly in the refrigerated sections. They have been found to deteriorate rapidly and require regular and competent inspection. Where no attempt at regular inspection and testing is made no reliance should be placed on these fire cuts at all, and in figuring the size of the line they should not be considered. Regular inspection and testing of all automatic devices, with prompt replacement of defective parts should be the rule instead *of the exception.* The

POWER AND HEATING

plant will be found one of the most important features of a brewery. One beer brewery, not by any means the largest, has eleven high pressure boilers. In an up to date plant the boiler room should preferably be entirely separated from the rest of the plant. If the boiler room communicates with any of the other buildings reliable cut-offs should be provided. As not a few plants, however, have interior boiler rooms, the construction of boiler room and arrangement, clearance and condition of boilers and care of boiler room should be well considered in passing upon such a plant.

THE PROCESSES

mainly to be considered are the barley-malting, grinding, cooking and refrigeration processes. The inspector is cautioned to pay particular attention to the recovery of spent grain where this practice is found to be in vogue. This feature has come to be an independent business and is not often carried on in the brewery itself. Where practiced, however, it considerably increases the hazard of the plant, and the reclaiming building should be entirely removed from other buildings of the plant. Many of the plants for the recovery of brewery refuse for cattle food have been badly damaged or destroyed by fire in the past few years, and while the moral hazard probably entered into some of the losses, many were due to trouble with the drying apparatus.

In a majority of breweries the "cooking" is done entirely by steam, and with proper equipment is a reasonably safe process. The malting of barley, or "malt growing," as it is sometimes called, as carried on in the larger breweries at certain seasons of the year, is usually done by the kiln process, with kiln house separated from malt house by a brick dividing wall. The malt house is a vault-like building, usually having a concrete floor. Wet barley is spread out upon the floors of the malt house, and when the malting or growing has progressed to the proper stage the grain is removed to the kiln house, where it is dried on the wire mesh floors by the heat of usually well arranged brick kilns. Openings in the wall dividing the kiln from the malt house should be well guarded by standard automatic cut-offs, and this wall should be not less than 12 inches in thickness. While occasionally a cause of loss, this process is not at all apprehensive in a well constructed and intelligently managed plant. The grinding of malt, another source of danger, can be safeguarded by properly enclosed mills provided with reliable magnets. These are necessary to draw out nails and particles of metal which frequently fall into the grain and, coming in contact with the grinders, would strike fire and ignite the grain. Anyone familiar with grain elevators or flouring mills will recall their use.

COOPERING AND STABLING

While a full fledged coopering plant is not always encountered in a brewery, even the smallest will at times re-cooper their own barrels. In either case the work should be done entirely away from the main values, and the process of boiling pitch should be properly safeguarded. In many cases re-coopering will be done in an open shed, with the flue pipe of the pitch kettle extending through the roof. In this case the surrounding woodwork should be properly cut away and the smokepipe should be provided with a metal collar. A cleanly condition is important in this section of the plant, and the usual good housekeeping conditions of the average brewery should be insisted upon as to cooperage. This is true also of the stable, and is particularly referred to here because these are two sections of the plant in which the management is apt to be lax, and as the strength of a chain is measured by its weakest link, it is entirely fair to condemn a brewery where no effort is made to keep cooperage and stable up to the high standard which is rather the rule than the exception in plants of this class. Lights throughout should be electric, installed under the approval of the board of underwriters having jurisdiction, and wiring should be regularly inspected, particularly in cold storage and stable sections. To an efficient equipment for

FIRE EXTINGUISHING AND WATCHMAN SERVICE.

Competent night, Sunday and holiday watch service, with an approved clock, should be required in every brewery. Special attention should be paid to the layout of the watchman's stations to insure the inspection of the entire plant. The numerous communications frequently found in breweries make it particularly easy for the watchman to invent short cuts, which at some time might prove disastrous to the welfare of the plant. The watchman should be provided with means of shutting off the flow of ammonia in case of necessity. Better still, there should be at all times a man on duty in the engine room capable of performing this important duty, as in the modern refrigerating systems about the only apprehensive features is the paralyzing effect of the ammonia fumes on the fire fighters. Water being a requisite of the plant, standpipes with ample lines of good hose can be readily installed in the buildings holding the main values; but where a regular department is maintained standpipes should have outside steamer connection. Many standpipe equipments are "a delusion and a snare" through lack of regular inspection and testing. Liberal fire pail service should be had, particularly in the cooperage and stable. A well equipped sprinkler plant would increase the desirability of a brewery from 25 to 100 per cent., *according* to construction and management.

IN CONCLUSION.

A writer of a previous article mentioned housekeeping as the last word as to warehouses, and this is true of every class of risk. Because poor housekeeping conditions are the exception rather than the rule, breweries of even poor or mediocre construction are apt to give fairly good satisfaction to the underwriter, while a brewery of superior construction throughout, or as to main values (and with values well separated), well managed and protected, may be considered a well nigh ideal risk.

THE FUR INDUSTRY.

A Brief Outline of the Fire Insurance Hazards Found in Fur Manufacturing—Preparation of Furs for Market.

By Gilbert E. Stecher, Inspector with the Home Insurance Company of New York.

HAZARDS.

This would incorporate the possibility of spontaneous combustion from the "scrapings," due to their fatty nature and the grease naturally coming from it, cleanliness being its only cure. I might state here that fur is a non-conductor of heat. The "drum," also, is a source of danger by reason of the process, that of taking charcoal fire to produce sweating. This, unless closely watched, will produce a serious result, as can readily be realized. As sawdust is used for cleansing purposes, there is generally a large amount kept on hand, this being spread out upon the floor for drying; and the premises are also covered with a fine dust due to "fly" while beating and cleansing. After the sawdust comes from the drums it should be removed from the building. In some plants will be found benzine in small quantities, which is used to remove blood spots, etc., from the fur. The use of bi-sulphide of carbon also adds a danger to the risk. Dry rooms never run above 90° Fahr., as it ruins the pelt. Most of the common hazards also pertain, such as heat, light and power, and should be carefully arranged. Dyeing is sometimes done, but this is small and aniline dyes used mostly. With careful supervision and cleanliness this class should show a low loss record.

Gentlemen, I will say here in regard to the loss record and adjustment of losses the record has been bad, but I am of the opinion that with careful selection and proper supervision the record can be improved, as it will be readily seen the hazards are not of a nature to be feared. The class of workmen is a decided objection, as they are mostly foreigners and ignorant, and this latter condition is more to be feared than any inherent hazard of the risk. Furs that have been burned are an evident loss, and furs that have been soaked with hot water are also considered a bad loss by experts.

Settlement of losses has been very unsatisfactory, for, as stated by one adjuster, there is more chicanery in the fur business than in any other. * *

The general process of "fur cutting" presents no particular hazard, but embodies many of the common ones which should be well guarded. The secretage of "carrotting" contains the only real feature of danger, and that is in the dryers. These in former years were heated by direct heat from fires or were placed over boilers. Where this practice still exists the hazard, of course, is great; but the more modern plants have fire resistant dryers, with proper vents, and the hazard in these plants is greatly ameliorated. The dryers in use at present do not conform to any particular style, but are constructed to suit conditions and requirements. These, where a high degree of heat is used, are of hollow tile set in angle iron frames, with metal roof at top, and provided with a tile or metal vent having good roof clearance. Here the steam pipes are used as racks, the skins being placed on wood racks or wood racks having a wire gauze bottom. An oven is also built which consists of an iron frame protected by asbestos, with iron pipe racks and a blower attachment for carrying off the fumes. Dryers using a low degree of heat are usually of wood, having the steam pipes at the bottom or sides. The storage of nitric acid should also be attended with care, and the main supply kept out of the building. Danger from hot bearings at the pickers is to be anticipated, as they run as high as 2,000 revolutions per minute (I saw one of these myself get hot). The storage of cut fur should be attended with great care, as it is damageable by water by reason of the mixing of the grades and having its life taken out. Fur is a non-conductor of heat, and, it is claimed, will not support combustion, as the air cells are not continuous.

This trade (as the fur dresser) employs an ignorant class of help, and seems to inhabit buildings that are conducive to bad losses, and I believe that it is this cause more than any that has made the class look bad to the underwriter. In consulting those familiar with the class as an underwriting venture I am given the following opinions:

"Almost always a total loss on cut fur, as they generally store same in basement, and it suffers severe water damage."

"Class should be good as the hazard is mild."

"No experience with the class, as a class, but fur losses have, as a rule, been fraudulent."

"As a class, bad; flash hazard, owing to finely divided fur present. Only good when sprinklered."

Despite any adverse opinions, I consider the hazard mild, and with proper selection and supervision a low loss record should be obtained.

STORAGE WAREHOUSES.

A Study of the Fire Underwriting Problems to Be Found in the Various Classes of Buildings Used for This Purpose.

By Robert D. Owen, Chief of Schedule Rating Department,
Willard S. Brown & Co., New York City.

The term "storage warehouse" is so indiscriminate in its application that it is made to fit any and all buildings which are used for the storage of all kinds of goods, from the most modern fireproof steel skeleton or reinforced concrete building specially constructed down to the ordinary joisted building, which may have been more or less extensively remodeled to meet the requirements for storage purposes.

USES OF STORAGE WAREHOUSES.

Many warehouses are used exclusively for the storage of a certain kind of goods or material; hence we have cotton, tobacco, sugar, paper and furniture warehouses. Others carry certain classes of goods. These are the chemical and cold storage warehouses. There are others which carry a great variety of merchandise, as, for instance, the department store warehouses. Some warehouses are used for storage only; that is, the goods are allowed to remain in the original package and are so kept until removed. In others a certain amount of work is done, such as sampling, sorting, repacking, etc. In liquor warehouses, cold process compounding; in flour warehouses, mixing, blending and bagging; in tobacco warehouses, the tobacco may be submitted to a sweating process, and egg candling is carried on in cold storage warehouses.

CONSTRUCTION.

There is no particular class of construction of buildings used exclusively for the storage of a particular class of goods. We find tobacco stored in all sorts of buildings, as we do sugar, cotton, paper, etc., and while we do not find many cold storage warehouses in frame buildings, they are plentiful enough in all classes of brick and fireproof buildings. But few classes of warehouses have any particular features of construction peculiar to that class, as the cold storage warehouse and the household furniture warehouse.

HOUSEHOLD FURNITURE WAREHOUSES.

A typical household furniture warehouse is one where each floor is divided into rooms for the storage of furniture of different individuals. The partitions separating the rooms depend largely upon the construction of the building in which they are found. In the inferior classes of warehouses only boards or corrugated iron on a wood studding form the partitions. In the best warehouses hollow tile is used, or else wire lath and plaster on metal studding with metal doors. In the modern warehouse the aim is not only to make the compartments fireproof, but they are made vermin proof, the idea being to keep the household goods as well as in the home.

A specially heated section is usually provided wherein to store pianos and other articles affected by change of temperature, and an even temperature is here maintained.

COLD STORAGE WAREHOUSES.

The special features of construction are the outer walls and the insulation. The walls are the same as for any building except that they are usually heavier. Sometimes they are built double with an air space between, or with a hollow tile lining within the outer brick wall, leaving an air space; in both cases the air space is filled with some insulating material.

INSULATION.

This is a question which has received much time and attention and is an all important one to refrigerating engineers. Notwithstanding this fact, primitive and inefficient insulation is to be found installed in warehouses of the present time, due either to ignorance, lack of capital or indifference. The most common method of insulating brick walls is to protect the wall against moisture from the outside by several coats of pitch or tar. Two by four studs are then set against the wall; two or more layers of ⅞ inch matched boards with waterproof paper between layers are nailed to the studs and the spaces between the studs filled with the insulating material, which may be charcoal, sawdust, shavings, granulated cork, or mineral wool. While the method may vary, the principle is essentially the same. In fireproof buildings tile is used instead of lumber.

The object of insulation is obviously to keep the cold air in and the warm air out. A fact well known is that still air is the poorest conductor of heat and is therefore the best insulator; but as the tendency of air is to circulate and thus allow the passage of heat by convection, it is necessary to confine the air in small spaces. With this object in view those light cellular materials are employed which for given volume and weight will contain the largest quantity of air in the most minutely divided particles, and which of themselves are poor conductors of heat.

We have already mentioned the most common materials, each of which has its advocates, but from a fire insurance standpoint mineral wool is assuredly the best, as it is the only fireproof material in the list.

A very effective insulation, and the one most recently employed, though somewhat expensive, is that of cork slabs laid alternately with pitch and Portland cement, with a finish coat of white cement mortar.

MECHANICAL REFRIGERATION.

This is a subject in itself and comes outside the scope of this article, and therefore it is only necessary to say but a few words along this line.

The process is based upon the principle that the evaporation of a liquid is brought about by heat, and the absence of heat is cold. Easily liquefied gases are evaporated in an enclosed space, thus exhausting the heat of that space and producing cold. The two almost exclusive mediums of mechanical refrigeration employed today are ammonia and carbon dioxide, ammonia being the most common.

There are two distinct systems; compression and absorption, compression systems in large plants and absorption systems being common to small installations, such as hotels, restaurants and office buildings. Cold is produced by these two systems by direct expansion, the liquefied gas being allowed to expand directly into coils of piping located within the room to be cooled or air is blown over these coils and circulated to "chill" rooms. With the "brine system," which is the more common, the liquefied gas expands into coils of piping immersed in a tank containing brine, which, thus cooled, is circulated in pipes through the "chill rooms."

The hazard involved with a refrigerating plant using either one of these systems is practically nil. To be sure a leaky or damaged ammonia system makes an atmosphere sometimes impossible for the firemen to work in, but otherwise a refrigerating plant need not give the insurance inspector any apprehension.

CLASSIFICATION.

Warehouses are classified in several different ways, as public and private warehouses, the latter, freely defined, being those where the contents are owned by one individual or a corporation. There are also free and bonded warehouses, the latter being those where the goods are stored under Government *bond* or control and cannot be removed until certain requirements have been complied with. The most satisfactory classification and the one best adapted to all conditions is that which gives a classification according to the goods in storage.

LISTED STORAGE STORES.

Within the metropolitan district of New York are located many storage warehouses called "Listed Storage Stores." These are divided into "Fibre" and "Non-fibre," a distinction made to denote those which store cotton and other vegetable fibre and those which do not.

In turn "Non-fibre" warehouses are divided into "stipulated," "non-stipulated" and "chemical."

Warehousemen sign an agreement stipulating that they will not store any fibre (in the case of a non-fibre warehouse), and to exclude from their premises explosives and all drugs of a poisonous or nauseous character. To be specific they agree to store no merchandise which would be poisonous or harmful to other merchandise stored in the vicinity.

Non-stipulated warehouses may store any goods at all except fibre.

Chemical warehouses are bound by a special agreement to store "separately from all other merchandise" a given list of chemicals, "maintaining such separation, each from the other, and from all other merchandise, by a substantial brick wall, not less than 12 inches in thickness, without doors or openings and extending through and above the roof."

This plan of classification and the rating methods of the New York Fire Insurance Exchange have brought influences to bear which tend to keep objectionable merchandise out of food stock warehouses and no longer cause apprehension among New York underwriters that a fire in a warehouse containing a grocery or food stock, "will result in a total loss on such stocks because of the leakage from poisonus substances, which might cause their condemnation by the Board of Health."

To state the matter in another way, if Paris green were stored on the next floor above a stock of foodstuffs, the latter would be completely ruined should water thrown onto the Paris green, in case of fire, leak through the floor onto the foodstuffs.

INSPECTIONS.

Regular inspections are made of the warehouses by the Board of Fire Underwriters to see that the warehousemen live up to their agreements and to check the contents.

Philadelphia and Chicago methods, while not so elaborately wrought out, have the same tendency to keep in separate warehouses materials which should not be stored together.

FIBRE WAREHOUSES.

This is a subject which requires special treatment and one to be considered by itself and not in the limited space which we must give to it.

The storage and handling of cotton, hemp, jute and sisal is largely restricted to specially designed and constructed buildings for this purpose. The buildings should be low, one story structures, with restricted areas; walls parapetted and coped, window openings limited and all walls blank as far as possible.

The height to which cotton bales may be piled must be restricted, and clear aisle space inside the walls and through the centre should be required.

FIRE PREVENTION AND PROTECTION.

Preventive measures are recommended, in the way of sprinkler equipment, watchman, special building signal, auxiliary fire department among employees, with fire pump, hose, etc. No smoking should be permitted on the premises, the carrying of matches should be prohibited and metal or fireproof lockers provided for employees' clothing. The stores should be allowed to be open only during the hours of daylight, so that no heat nor lights will be necessary.

Good housekeeping should be insisted upon, and no sampling allowed except on the dock.

Nearly all present day methods can be and are applied to the protection of storage warehouses, even to the installation of automatic sprinklers in many cold storage plants, the practicability of which is a question which experience alone can settle; the most common protection being fire buckets and casks of water, chemical extinguishers and automatic alarm.

HAZARDS AND RECOMMENDATIONS.

There are the common hazards of heating and lighting with which everyone is familiar. In the free and bonded warehouses no heat should be allowed except a small gas radiator or small coal stove in the office.

Only gas or electric light should be allowed in the office and locked lanterns burning signal oil throughout the rest of the building. These lanterns should be cleaned and filled on a metal table and the oil supply kept in a fireproof room or a metal lined compartment. The motor room should be preferably of fireproof construction, otherwise metal lined. The drum hole to the motor room should be reduced to a minimum, and self-closing cans should be provided for any oily waste.

The most essential requirement is that rubbish and litter be not allowed to accumulate beneath stairs, where it is a menace and only waits a careless match to set it afire. With dust and a bit of oily waste it becomes liable to spontaneous ignition Floor openings should be limited and stairs and elevators and hatches trapped. Windows should be shuttered and all walls parapetted and coped.

In cold storage warehouses egg candling should only be done by electric light, as the use of oil lamps is dangerous. Where polishing or retouching is done in furniture storage warehouses, care should be observed that all oily rags are kept in self-closing cans during the day and burned at night. All varnishes and turps should be kept in a fireproof vault or outside the building. If sulphur bleaching is done in a hop warehouse, the sulphur pan should be set on a metal or brick base so that the floor will not become ignited in case the pan becomes very hot and the sulphur boils over.

The rules and regulations as laid down by boards of underwriters, if followed, would make conditions well nigh ideal, and when the final word has been said the question of housekeeping is the important one and well kept storage warehouses may be looked upon by underwriters as good business.

THEATRES.

An Exposition of the Construction, Fire Hazards, Methods of Fire Prevention and Protection of Fireproof Theatres.

By Charles C. Dominge, Insurance Engineer, New York City.

"In the great theatre fires of history the loss of life has commonly resulted from the rapid spread of flame on a stage covered with scenery followed within two or three minutes by an outpouring of suffocating smoke through the proscenium arch into the top of the auditorium before those in the galleries could escape. Death has come chiefly to those in the balconies and within less than five minutes after the first alarm."*

THREE GREAT SAFEGUARDS.

1. The providing of ample automatic quick opening smoke vents over the stage.
2. The thorough equipment of the stage with automatic sprinklers.
3. Providing ample exits.

One may gather some slight idea of the hazard of a theatre, when on December 18 last, our daily papers in startling headlines announced, "Three Theatre Fires in a Day." In each case the fire broke out during the matinee performance. Statistics tell us that nearly five hundred theatres were completely destroyed during the past 100 years throughout the world. Of these, thirty-seven theatres were burned twice; eight, three times; four, four times, and the Old Bowery Theatre, in New York city is credited with burning down five times.

Theatres as a rule do not reach a ripe old age, twenty years being practically the limit. Of course this average was arrived at before the present "up to date" fire resisting construction was in vogue. There are two periods in the life of a theatre as regards fire; the first five years from the time of the construction, on account of everything being new, and not in perfect running order, and secondly, after about thirty years, when the wear and tear of apparatus and construction begin to show themselves.

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* Extract from National Board of Fire Underwriters.

Theatres are safest during the day, the danger increases just before performance time, owing to making ready, lighting, etc. It is reduced during performances, as actors, scene shifters and the fireman are then alert with their eagle eyes. The time immediately following the descent of the final curtain is where a theatre is the most hazardous of all times, as the lights are immediately turned out and nearly every one in front and back of curtain is anxious to get home.

THE LOCATION.

The ideal theatre should be isolated, i. e., on a square or block, with a street on the four sides and no building should be within 100 feet. Of course, in a big city like New York, where property is so valuable, we must be satisfied with a court of from 10 to 15 feet on all sides.

THE PLAN AND CONSTRUCTION.

The plan of a theatre consists of dividing the same into its various parts, such as the auditorium, stage, dressing room, boiler room, etc., buildings with the necessary fire walls, communications and floor openings.

Walls should be brick or concrete at least 16 inches thick, parapetted and coped, and no furring or other combustible material allowed on interior of walls, a standard finish being, first, a coat of asphaltum on wall, and then plaster only as a finish. Floors and roof should be on steel beams, with either brick, terra cotta or concrete arches between. The span of beams should not exceed five feet. The topping on the roof should be tile or plastic slate. If the floors are of wood, they should be without air space, i. e., have sleepers imbedded in cinder concrete filling. The cornice should be brick or terra cotta. All windows should be of wired glass in hollow metal frames. Shutters should be metal clad, lock-jointed. Galleries and balconies should be entirely of steel (cantilever type), with brick, terra cotta or concrete arches between beams. The stepping if of wood should be laid without air spaces.

The front of balconies or galleries should be steel framework, with concrete or other non-combustible facing; sheathing is not approved. Seats should be of metal design, the wood strips to fasten seats down to be imbedded in the concrete. The boxes should be on a steel frame, with steel floor beams and have brick, tile or concrete arches. The front of boxes should be the same as the front of galleries. Stairs leading to boxes, galleries and balconies should be on steel frame, with marble or slate treads, with metal plates at least ⅛ inch thick under same. Landings should be fireproof. Enclosures to stair should be either brick, terra cotta or concrete. All iron work throughout must be protected with at least 2 inches of terra cotta or 2 inches of Portland cement concrete on wire mesh.

All roof members, including struts, soffits and lower flanges should be protected as above. Suspended ceiling should be constructed of wire lath and at least 2 inches of Portland cement concrete, and opening into same should be from outside of building only. This space is not to be used for any purpose except the ventilating system. Wide aisles leading to numerous exits to street or fire escape, having doors which open outward, should be provided. The

STAGE BUILDING

is usually a high one story building equal to six stories with a deep basement. Walls should be brick or concrete at least 16 inch, parapetted and coped. The roof should have a steel truss with steel beams and either brick, terra cotta or concrete arches, span about 5 feet. The roof topping should be tile or plastic slate, the cornice brick or terra cotta, and the windows of wired glass in hollow metal frames; shutters, if any, to be standard lock-jointed. The stage floors in wings each side of stage to be of steel and brick, tile or concrete arch, supported by protected cast iron columns or brick wall.

Wood flooring is permitted only on the working part of stage. The fly galleries, which are located at the sides of the stage, should be constructed of steel beams and fireproof arches. These are used to handle the drops, etc., and are at quite an elevation above the stage floor. The painter's bridge is always located against the rear wall of the stage, connecting the fly galleries. This should be built of steel slats laid about 2 inches apart. Above the fly galleries, about 5 feet under the stage roof, is the gridiron (sometimes called rigging loft), built entirely across the stage of steel slats about 2 inches apart.

One look at this portion of the stage would convince the novice that he was in a "rope walk," as pulleys, drums, blocks, etc., abound here. An iron ladder should be provided on the outside of the building with an opening into the "grid." All metal members, including the stage roof (excluding the grid), should be protected with at least 2 inches of Portland cement, concrete or 2 inches of terra cotta. A metal ventilator in the stage roof, with riveted metal louvres at the sides and a drop damper arranged to open automatically, would tend to create a current of air from the auditorium and thereby prevent the smoke and flame from escaping into the auditorium.

PROSCENIUM WALL.

This is the "real" hazard of a theatre, and if we could overcome the immense opening between the stage and the auditorium we would seldom hear of a disastrous theatre fire. The proscenium wall should be built of brick (thickness to be same *as the outside* walls, never less than 16 inches), with 4 inch pilasters, and should extend the entire width of building. It must start at the ground and extend at least 4 feet above the auditorium roof and be coped. If stage building is the highest. wall should extend 4 feet above same. The steel girder over the proscenium opening must be protected with at least 2 inches of Portland concrete cement. There must be a relieving arch in the proscenium wall over the steel girder. This is compulsory, as it relieves the weight of the wall resting on said girder. The proscenium wall under the stage should extend to the under part of the stage flooring level, or flooring should be cut away the width of the curtain and filled in with concrete. This would form a complete separation of the stage floor from the apron.

The only openings allowed in the proscenium wall should be the curtain opening and not more than two others, to be located either below stage level, or one on either side of stage on first floor; *no opening of any kind should be permitted above the first floor.* Openings are not to exceed 21 square feet, each with 3 inch standard double lock-jointed tin-clad automatic fire doors on each side of the wall. Only one standard automatic fire door is required at openings to musicians' pit.

The proscenium frame should be of non-combustible material, i. e., wire lath and plaster, stucco or concrete.

FIRE CURTAIN.

A curtain of steel and asbestos, 4 inches thick is preferred, but if made of asbestos only, the same should be reinforced with wire or have wire spun in the asbestos.

The chief object of the curtain is to localize a stage fire, and to cut off the fire and the smoke, and should be able to withstand the increased air pressure due to heat until the fire department arrives.

The curtain must be at least 36 inches wider than the openings in the proscenium masonry, i. e., 18 inches each side, and at least 24 inches higher than the highest point of the proscenium opening. The curtain must operate in guides constructed each of one 6x12x½ inch angle, and one 4x5x½ inch angle, riveted together to form "Z," bolted every 2 feet with ½ inch bolts through the proscenium wall, and extend to a height of not less than 3 feet above the top of the curtain when raised to its full limit. Guides or channels must be at least 22 inches from the edge of brick or concrete wall (not stucco or plaster), and the clear space between the wall and the angle not to be over 6 inches. Curtain must set in slot of channel at least 12 inches.

There should be a wrought iron or rolled steel bar or pipe (not less than 2½ inches diameter) properly attached to top and bottom of curtain. To the top bar attach ⅜ inch wrought iron emergency chains, also to top bar attach four steel cables ½ inch diameter by approved clips around entire bar not less than 6 and not over 7 inches apart, cables to be attached to drum at least forty times their diameter.

Standing cables (which is the cable the curtain is attached to and operated on) should be strand wire cable not less than ⅜ of an inch in diameter with iron brackets fastened by bolts through the proscenium wall at a point at least twice the height of the curtain plus 5 feet above the stage level. The lower part of the standing cable should pass through the stage floor through metal bushed holes and to be attached by iron bracket to the proscenium wall. Turnbuckles are necessary to keep cables taut. Weights are not permitted.

Curtain guide clips at sides should be metal eyelets attached to the curtain by clips, spacing not to exceed 18 inches centre to centre. Lignum vitæ or metal rings to be at least ¾ inch larger than curtain cable.

The manner of tripping the steel and asbestos curtain should be by means of 5-16 inch steel cables on each side of stage, these whenever pulled should release the curtain and allow it to descend. These trip cables should run from the stage level up along each side of the curtain and pass over grid to the releasing clutch on the operating shaft.

In theatres already constructed we could accept the "old style" lash line with knife and sign at the stage. This is an ordinary hempen cord attached to bottom of counterweight of curtain, thence continuing down side of arch, then under stage, then up other side of arch, then over top of arch to a weight. If this cord is cut or burnt on either side of stage curtain will descend.

Nest of sheaves should be steel and fastened to grid or proscenium wall. Proscenium curtain should not be placed nearer than 3 feet to footlights.

SKYLIGHTS OVER STAGE.

Thin glass on metal frame skylight occupying at least one-eighth of stage area should be installed. Skylights to be fitted with rolling sash and glazed with glass one-eighth inch thick and no pane to exceed 300 square inches. Rolling sash should be fitted with brass wheels not less than 2½ inches in diameter; the latter should roll on brass plate on iron frame extending entire length of sash. The skylight must be set on curb so that the lowest portion of the tracks will not be less than 12 inches above the roof. The angle of the skylight frame to be on the basis of 1 inch rise to 1 foot length.

The skylights should be so constructed as to open instantly on the cutting or burning of a hempen cord which should be arranged to hold the skylights closed. The said ropes should come together at the first fly galleries by iron triangle and then by *single rope* to the stage with knife and sign. A fusible link also to be placed on ropes directly under skylight. Skylight frames to close under metal hood at top, sides and bottom with metal aprons lapping 4 inches downward to prevent the elements lodging on sand.

DRESSING ROOM BUILDING.

The dressing room building should be in a separate fireproof section, cut off from the stage or other sections of the theatre building by at least a 12 inch brick or concrete fire wall, properly parapetted and coped, and all openings to be protected by 3 inch, double lock-jointed, tin-clad fire doors, arranged automatically on each side of the wall, unless stage building and dressing room building are equipped with standard sprinklers, in which case only one 3 inch standard door need be installed. The construction of this building should be the same as the auditorium, i. e., steel and brick, concrete or tile arches. The stairs should be steel frame with metal treads under and be enclosed in fireproof halls with standard doors. All individual dressing rooms should be separated by at least 4 inch terra cotta partitions on angle iron frames, or 4 inch concrete partitions, with a standard fire door to each room. *Dressing rooms are not permitted on the stage,* under the stage, on the fly galleries *in or under* the auditorium.

PROPERTY, REPAIR AND OTHER SECTIONS.

All buildings used for carpenter shop, property rooms, bill poster, electrical repair shop, storage, scenery, costume manufactory, or boiler room should be of fireproof construction and cut off from the stage or theatre building by at least a 12 inch brick or concrete wall, parapetted and coped, and all openings protected by 3 inch double lock-jointed, tin-clad fire doors, one each side of wall, unless sprinklered, in which case one standard door will suffice.

HEATING.

Steam or hot air (by means of blowers and steam coils) should only be used. Flues to be at least 8 inches. Coal stoves or gas radiators should not be permitted.

LIGHTING.

The lighting should be electricity, wiring to be approved by the underwriters having jurisdiction. Gas should only be permitted in the auditorium, for emergency purposes only. *No gas* lights of any kind should be permitted behind the proscenium wall, although some underwriters permit small metal boxes, with the gas light inside, and outside protected by strong wire mesh, to be used in dressing rooms for curling irons. No alcohol lamps, candles or gas lights (except as mentioned), should be permitted in these rooms. *By the discontinuance of the gas flame in the* *theatre its greatest hazard is eliminated, as in days gone by nearly every fire was attributed to this cause.*

FIRE PROTECTION.

A standard standpipe system should be installed, all piping to be at least 4 inches in diameter, the risers to be located so as to provide the following outlets: One each side of the stage, also under the stage, one each side of auditorium, one in each fly gallery, one in lobby and one each floor of dressing room building, and each outlet to have at least 25 feet of standard cotton hose, with nozzle and gate valve. Standpipe should be supplied from a standard tank on stage roof, elevated at least 20 feet high, unless city pressure is sufficient to provide an equivalent pressure. In conjunction with the above, an approved system of wet pipe sprinklers must be installed over the stage, in the dressing rooms and other sections, excluding the auditorium. The same rules as to spacing of sprinkler heads and pipe sizes should apply as in other buildings. A gravity tank, with conical cover and round hoops, and not less than 10,000 gallons capacity should be situated at least 20 feet above stage roof on brick walls and protected iron girders. This tank should be protected from freezing in winter. An automatic fire pump capable of supplying at least 750 gallons of water per minute should be installed; also a standard alarm valve and steamer connection. Controlling valve under gravity tank should have extension to stage with hand wheel at convenient level.

Some theatres are further protected with a pressure tank of at least 7,500 gallons capacity, giving 75 pounds on the highest line of sprinklers, a reservoir in basement containing 25,000 gallons of water as supply for fire pump, and a line of approved sprinklers placed immediately above the proscenium opening, which will give a regular water curtain in case of fire. Casks of water (40 gallon capacity), painted red and marked fire, and approved buckets, some filled with sand and others with water, also approved fire extinguishers, axes and hooks, should be installed on the stage, each side, under the stage, in the fly galleries, property, scenery and repair shop. An approved watchman's clock should be installed, watchman recording hourly rounds throughout entire building, nights, Sundays and holidays. On the stage a special building call should be connected direct to fire headquarters.

A NEW HAZARD.

Although the "blood and thunder" play, with its actual fire scenes, explosions or firing of pistols with "paper wads" is almost a relic of the past, the "moving pictures" now occupy the centre of the stage. Aside from the hazardous nature of the films the inspectors should insist upon the wiring being made according to requirements, machine enclosed in fireproof room, and be operated by hand power. Also determine whether the automatic shutter is working properly, and non-heating rheostat installed.

SMOKING.

Smoking should not be permitted except by the actors, if called for in the play, and extreme care should then be taken to insure the extinguishment of not only cigars or cigarettes but of matches as well.

IN CONCLUSION.

There are many items, such as roof garden, tenants, fireproofing scenery, safeguarding of life, etc., not covered by this article, as space will not permit, but it is hoped that the "beginner" in the inspecting or underwriting business may glean *some* "pointers" regarding a theatre.

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